“EVALUATION OF MRCP IN BILIARY OBSTRUCTION WITH ERCP, HISTOPATHOLOGICAL CORRELATION”

DISSERTATION SUBMITTED TO

THE TAMIL NADU Dr. M.G.R MEDICAL UNIVERSITY, CHENNAI

IN PARTIAL FULFILLMENT OF THE REGULATIONS FOR THE

AWARD OF DEGREE OF M.D IN RADIODIAGNOSIS.

BY

DR. SITARA GOPLAKRISHNAN

GUIDE

DR. B. DEVANAND

DEPARTMENT OF RADIOLOGY

PSG INSTITIUTE OF MEDICAL SCIENCES AND RESEASRCH

PEELAMEDU, COIMBATORE – 641004

TAMILNADU, INDIA

“EVALUATION OF MRCP IN BILIARY OBSTRUCTION WITH ERCP, HISTOPATHOLOGICAL CORRELATION”

DISSERTATION SUBMITTED TO

THE TAMIL NADU Dr. M.G.R MEDICAL UNIVERSITY, CHENNAI

IN PARTIAL FULFILLMENT OF THE REGULATIONS FOR THE AWARD OF DEGREE OF M.D IN RADIODIAGNOSIS.

BY

DR. SITARA GOPLAKRISHNAN

GUIDE

DR. B. DEVANAND

DEPARTMENT OF RADIOLOGY

PSG INSTITIUTE OF MEDICAL SCIENCES AND RESEASRCH

PEELAMEDU, COIMBATORE – 641004

TAMILNADU, INDIA

"EVALUATION OF MRCP IN BILIARY OBSTRUCTION WITH ERCP, HISTOPATHOLOGICAL CORRELATION"

DISSERTATION SUBMITTED TO

THE TAMIL NADU Dr. M.G.R MEDICAL UNIVERSITY, CHENNAI

IN PARTIAL FULFILLMENT OF THE REGULATIONS FOR THE AWARD OF DEGREE OF M.D IN RADIODIAGNOSIS.

BY

DR. SITARA GOPALAKRISHNAN

GUIDE

DR. B. DEVANAND

DEPARTMENT OF RADIOLOGY

PSG INSTITIUTE OF MEDICAL SCIENCES AND RESEASRCH

PEELAMEDU, COIMBATORE – 641004

TAMILNADU, INDIA

CERTIFICATE

PSG INSTITIUTE OF MEDICAL SCIENCES AND RESEASRCH

COIMBATORE

This is to certify that the Dissertation work entitled “Evaluation of MRCP in biliary obstruction with ERCP, Histopathological correlation” is the bonafide work of Dr. Sitara Gopalakrishnan in the department of Radiodiagnosis, PSG Institute of Medical Sciences and Research, Coimbatore in partial fulfillment of the regulations for the award of degree of M.D in Radiodiagnosis.

Dr. B. Devanand

Professor

Department of Radiodiadnosis

PSG IMS & R

Dr. S. Ramalingam

Principal

PSG IMS & R

Place: Coimbatore

Date:

ACKNOWLEDGEMENT

Foremost, I would like to express my sincere gratitude to my professor and guide Dr. B. Devanand for his ever friendly co-operation which was present throughout the preparation of this work. This work would not have been possible without his guidance, support and encouragement. Dr. B. Devanand will always be a key inspiration to me.

I would like to thank Dr.S. Ramalingam Principal of PSG medical college for providing me with the opportunity and resources to accomplish my research work.

I would like to thank and express my sincere gratitude Dr. Prerna garg ratanlal, Assistant Professor for providing me with the motivation to complete my research work and helping me with the statistical analysis and proof reading, enabling me to complete this study. Dr. P. Prerna garg ratanlal’s knowledge in field of research and command over the English language has immensely helped in framing and formulating this thesis. She was very supportive right from the beginning to the end stages of my research work and helping me battle minor indifferences and providing me with valuable practical tips which were valuable in completing the work.

I would like to extend my gratitude to Dr. Salil Pande whose timely help and support enabled me in completion of my research work.

I would like to thank Dr.L.Venkata krishnana, Professor and Head, Department of Gastroenterology, who has been kind in guiding me through the entire process of the research work. I would also like to extend my heartfelt thanks to all the faculty of Gastroenterology, for helping me in providing ERCP data.

I would like to thank my fellow postgraduates and my dear friends Dr V.B Arun kumar and Dr.S. Sukithra for their immense support during the entire period of my study and for providing me the valuable help and support, and for making my college life unforgettable. They have helped me in various aspects of the study, aiding completion of my thesis work.

My special thanks to my friend Dr. Pradeep Rangaswamy for helping me in statistics and in framing and formulating my thesis. He has helped me in various aspects of the study, aiding completion of my thesis work. Without his immeasurable help it would not have been possible to complete my thesis.

I am very thankful and grateful to my family. Words cannot express how grateful I am to my father Mr.K.G.Gopalakrishnan, my mother Mrs.K.Shyamala, my sister Ms.Thushara and, for all the sacrifices that they have made on my behalf. Your prayers for me was what sustained me this far. My exceptional gratefulness goes forever to my grandmother, Mrs.Sharadha, whose blessings and guidance has brought me a long way in the journey of life.

Last, but not least, I would like to express my heartfelt gratitude to all the patients who had participated in this study.

ABSTRACT

AIM: To evaluate the efficacy of MRCP as a diagnostic tool as compared to ERCP in diagnosing extra-hepatic biliary abnormalities like choledocholithiasis, strictures and malignancies in diagnosing other ancillary findings like biliary ductal dilatation and abnormalities of pancreatic duct. Histopathological correlation is made if available.

MATERIALS AND METHODS: A prospective study of 50 consecutive patients with biliary obstruction referred for MRCP with subsequent assessment by ERCP/ histopathology were included.

RESULTS: MRCP had sensitivity, specificity of 100% in IHBR strictures, 87.5% and 100% in bile duct stones, 84.6% and 94.3% in CBD strictures, 100% in biliary dilatation, 100% in bile duct tumor, 100% and 97.9% in gall bladder stones,100% and 97.9% in pancreatic dilatation, 0% and 98% in pancreatic duct variant,100% and 97.9% in ampulla stones, 0%and 97.9% in ampullary strictures, 50% and 97.9% in ampullary tumors respectively.

CONCLUSION: We concluded that MRCP has high diagnostic accuracy and is equivalent to ERCP in diagnosing IHBR strictures and CBD tumors. In cases of CBD strictures and CBD stones MRCP is comparable to ERCP. In our study MRCP shows increased sensitivity in detecting ampullary tumors than ERCP. Owing to a small study population, results for other biliary pathology were inconclusive.

Key words: MRCP, ERCP, Biliary obstruction

TABLE OF CONTENTS

INTRODUCTION

Obstructive jaundice is caused by biliary obstruction, which is due to blockage in any of the ducts that carry bile from liver to gall bladder and then to the small intestine. The causes of obstructive jaundice are classified as intra-hepatic or extra hepatic. Hepatitis, cirrhosis and hepato-cellular carcinoma are the commonest intrahepatic causes. Extra hepatic causes are divided into intra-ductal and extraductal etiologies. Neoplasm, choledocholithiasis, biliary strictures and primary sclerosing cholangitis form the major causes of intraductal obstruction. Extraductal causes include compression of biliary channels by neoplasms, pancreatitis, and cystic duct stones (Mirzzi's syndrome). The commonest cause of Obstructive jaundice is stones.

Obstruction of the biliary tract with different benign and malignant processes is a common clinical problem which requires accurate localization and discrimination of pathology.

Once cholestasis is detected clinically or biochemically patients are usually referred for USG abdomen as the primary imaging investigation.

In the evaluation of a suspected biliary obstruction, the initial choice remains as Transabdominal ultrasound due to its ready availability, non-invasiveness and inexpensiveness.

An excellent clue in finding biliary obstruction in ultrasound has been ductal dilatation. However, ultrasound cannot identify the cause and level of obstruction accurately. Moreover, it is an operator dependent procedure and due to overlying bowel gas or obesity, it can provide only suboptimal imaging of retroperitoneal structures. [1]

Hence arose the need for a non-invasive, radiation free, non-operator dependent, multiplanar imaging modality which can help not only to identify the obstruction but also demonstrate the nature of the pathology. Magnetic resonance cholangiopancreatography is one such modality which was initially introduced in the year 1991 and has been improved since then, to the point where it is considered at par with Endoscopic retrograde cholangioancreatography.

Endoscopic retrograde cholangiopancreatography has been considered as gold standard in diagnosing bile disorders, but it is invasive and requires endoscopic cannulation, sedation, the use of ionizing radiation. In addition, ERCP may be associated with significant complications such as hemorrhage, sepsis, pancreatitis, bile leak and mortality.

. MRCP refers to the selective fluid sensitive magnetic resonance imaging (MRI) of pancreatic and biliary ducts. MRCP has the advantage of potentially avoiding mortality and morbidity associated with ERCP.[2] Also, when conventional T1- and T2-weighted sequences are combined together, detection of extraductal disease by MRCP is possible.

We, in our prospective study wish to determine the diagnostic efficacy of MRCP considering ERCP as the gold standard and whether the MRCP can replace ERCP for diagnosis, while ERCP can solely be reserved for therapeutic applications.

AIMS AND OBJECTIVES

AIMS AND OBJECTIVES

- To evaluate the efficacy of MRCP as a diagnostic tool as compared to ERCP in diagnosing extra-hepatic biliary abnormalities like choledocholithiasis, strictures and malignancies.

- To evaluate efficacy of MRCP in diagnosing ancillary findings like gall stone disease, biliary ductal dilatation and abnormalities of the pancreatic duct.

- To correlate the findings with histopathology if available.

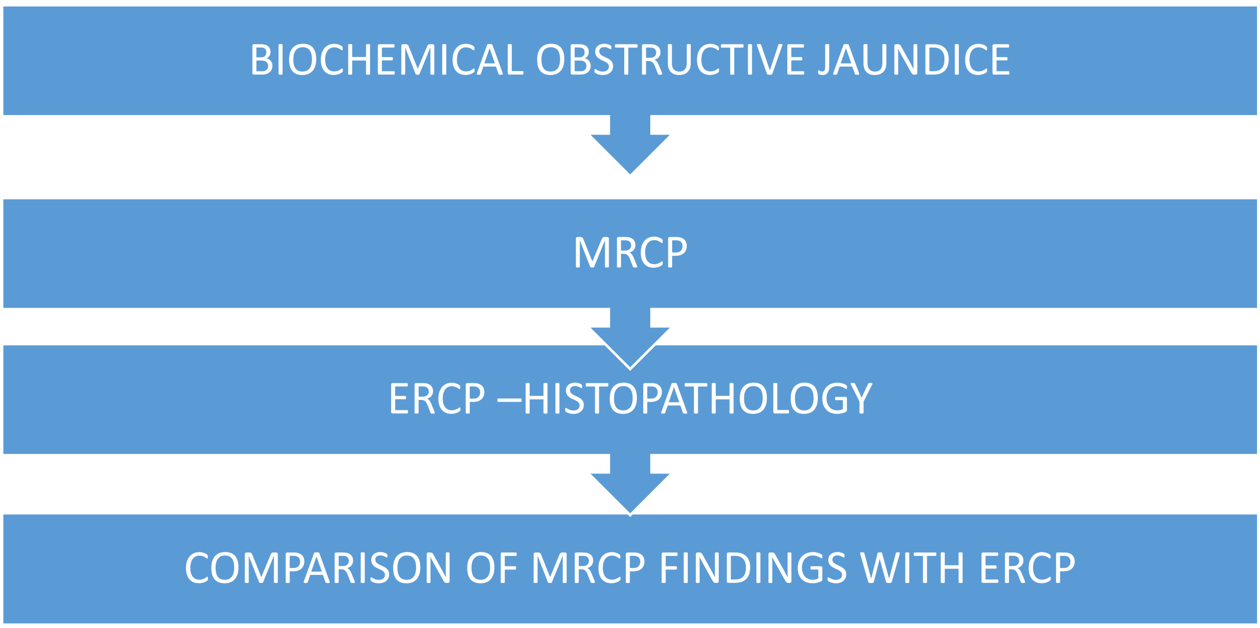
MATERIALS AND METHODS

MATERIAL & METHODS

A prospective study of 50 consecutive patients with biliary obstruction referred for MRCP with subsequent assessment by ERCP/ histopathology were included.

The study was conducted at MRI and ERCP units in a tertiary care center. MRI scanner used was, 1.5-T scanner (Magneton Avanto, Siemens, Erlangen, Germany) using an in-house using 16 channel body coil.

STUDY DESIGN



INCLUSION CRITERIA:

- All consecutive patients undergoing Magnetic resonance cholangiopancreatography with features of biliary obstruction & subsequently assessed by Endoscopic retrograde cholangiopancreatography / histopathology.

EXCLUSION CRITERIA:

- Patients having a contraindication for MRI – like cardiac pacemaker/cochlear implant/non MR compatible clips used on brain aneurysms/claustrophobia.

- Patients lost to follow up.

- Patients not further assessed with ERCP/Histopathology

Pre-procedural preparation included six hour duration of fasting which helps in promoting filling of gall bladder. Usually, it takes about twenty minutes to complete the full examination.

Following sequences were obtained-

1. Localizer in 3 planes
2. Axial T1 In- phase trufisp
3. Axial T2 HASTE fat sat
4. Coronal T2 HASTE fat sat
5. Thick Slab HASTE
6. 3D Volume Respiratory triggered MRCP, in two planes (coronal section in plane with CBD, and axial section in plane with pancreatic duct).

The protocol parameters of sequences are as described in table -1.

Table 1. Parameters used in various sequences

Parameters	T2W breath hold HASTE	3D T2W FSE with respiratory triggering	T2W breath hold HASTE fat saturated thick slab	T1W sequence Breath hold In phase	TRUFI sequence with respiratory triggering
TR/TE(ms)	2000/92	3748/702	4500/792	174/7.15	4.0/1.71
Number of averages	1	1	1	1	1
Flip angle	180	180	180	70	70
FOV	400x325	261x261	349x349	400x299	400x300
Matrix size	320x260	320x320	384x384	288x216	320x240
Slice thickness(mm)	6mm	10mm	40mm	6mm	4mm
Slice gap(mm)	7.2mm	0mm	NA	40mm	0mm
Number of slices	30	19	1	20mm	30
Acquisition plane	Axial	Coronal oblique	coronal	Axial	Axial, coronal
Half-Fourier factor	5/8	Phase encoding:7/8	Phase encoding off	Phase encoding off	Phase encoding off
Receiver bandwidth	473	200	277	230	504
Turbo factor	211	119	307	None	None
Oversampling	None	20%	Slice: 33%	None	None

An axial and coronal fat sat 2D breath-hold HASTE sequence was acquired covering the entire liver, up on to duodenal ampulla .This was usually performed using two breath-hold /respiratory triggered acquisitions.

3D respiratory-triggered heavily T2-weighted FSE sequences are performed in coronal plane and also in the axial oblique plane. Respiratory triggering was attained by using a navigator sequence which applies a MR pre-pulse so that respiratory motion can be monitored. The navigator was placed on the edge of diaphragm on the coronal localizer and sagittal localizer. Triggering of image acquisition was done when the diaphragm interface with the lung falls into a pre specified window of acceptance. In such a way the imaging slice from a consistent position was achieved.

Throughout this acquisition, the patient was instructed to breathe regularly. This acquisition took four to six minutes to complete. A stack of 30 contiguous slices with 1.5mm thickness were obtained. Owing to the heavily T2-weighted images, high signal intensity represents pancreatico-biliary tree with structures adjacent to it appears as decreased signal intensity. Strictures or small filling defects present in the pancreatic or biliary ducts are best appreciated in this sequence.

From this volume of data, MIP reformats were obtained. Highest signal intensity pixels along a ray which was perpendicular to the plane of projection is only displayed. In this way fluid and bile-filled structures are highlighted strongly. If needed MIP reformats were obtained in planes such as coronal and sagittal oblique.

Additionally high resolution radial slice acquisitions, thick slab (4 cm) fat saturated HASTE sequence were performed if required.

T1 weighted in phase GRE images and TRUFI images acquired in axial and coronal planes. Contrast enhanced T1 W fat saturated images were acquired if needed.

MRCP was performed prior to ERCP and the results were evaluated by two radiologists with 5yrs and 20 yrs of experience and their consensus was obtained.

ERCP was performed by well trained and experienced endoscopist. Cholangiograms were obtained and compared with MRCP findings.

Considering ERCP as gold standard the sensitivity, specificity, positive and negative predictive values of MRCP were evaluated. If available correlation with histopathology was also made.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

BILIARY SYSTEM

Multiple channels carry bile from the hepatic parenchyma to the duodenum. This constitutes the biliary tree.

The biliary tree can be classified as intra hepatic and extra hepatic bile ducts.[3]

INTRAHEPATIC BILE DUCTS:

All these biliary canaliculi unite to form segmental bile ducts and their drainage occurs in the following pattern:

The right posterior duct which courses more horizontally drains the segments VI and VII. The segments V and VIII drain into more vertically oriented right anterior duct.

The right hepatic duct is formed by union of the right anterior and right posterior ducts. The left hepatic duct is formed by union of segmental bile ducts draining the second and fourth segments. The common bile duct is then formed by the combination of left hepatic and right hepatic ducts. The segment I Bile ducts drain in to angle of their union.[4]

The ducts of the left hepatic lobe are more anterior than those of the right lobe. It is important, particularly when contrast cholangiogram is performed because contrast may not opacify independent ducts.

EXTRAHEPATIC BILIARY SYSTEM:

The common bile duct is formed by the cystic duct from the gallbladder joining with the common hepatic duct. The initial course of the common bile duct courses is along the free edge of lesser omentum, from where it travels posteriorly and reaches the pancreas and duodenum. The ampulla of Vater is formed by common bile duct joining with the main pancreatic duct. The major duodenal papillae in D2 segment of duodenum is drained by the Ampulla of Vater.[5]

The biliary tree anatomy is as depicted in line diagram fig (1)

MRCP:

Magnetic resonance cholangiopancreatography is a non-invasive imaging technique that uses magnetic resonance imaging as a means to visualize the biliary duct and the pancreatic duct, without the need for contrast. This was introduced in 1991, and since then, the spatial resolution of this technique has improved considerably.

MRCP functions with heavily T2-weighted sequences and highlights static fluids or fluid filled slow moving structures like the pancreatic and bile duct. The ducts will appear hyper intense. Coronal T2-weighted images viewed as thin collimation images (3-5 mm), and it is subsequently processed to obtain a MIP (maximum intensity projection) image which is a cholangiogram like projectional image. Coronal thick slab (30 to 50 mm) can also be obtained, to produce the same effect in a very short time (<5 seconds). Usually both these are obtained to achieve higher accuracy.

Latest magnetic resonance equipment allow us to perform MRCP as fast as within fifteen minutes. This is because of the availability of ultra-fast sequences. At present, MRCP is performed widely as a modality of primary imaging, used in assessing conditions like obstructive jaundice and other pancreatico-biliary duct abnormalities that may be benign or malignant.[6]

The MRCP anatomy of biliary tree is as shown in the fig (2).

ERCP:

Endoscopic retrograde cholangiopancreatography (ERCP) is a technique that combines endoscopy and fluoroscopy for diagnosing and treating biliary or pancreatic ductal abnormalities. An endoscope with a camera and light at the end is inserted through the esophagus, to the stomach and to the duodenum. Contrast media is injected in to the biliary and pancreatic ducts which are visualized on X-rays. ERCP additionally offers an advantage of treatment once the diagnosis is established. Stenting, sphincetrotomy or gall stone removal can be performed in the same sitting. Biopsies can also be taken for tissue diagnosis.

The ERCP anatomy of the biliary tree is as shown in the Fig 3.

Coakley FV et al assessed the efficacy of MRCP in imaging pancreatic and biliary duct pathology. The study explains the procedure of Magnetic resonance cholangio-pancreatography (MRCP) and its uses. He quotes that “MRCP is used to visualize fluid in the biliary and pancreatic ducts as high signal intensity on T2-weighted sequence and it is the newest modality for biliary and pancreatic duct imaging”.

MRCP is already known for its usefulness in an array of pancreatic and biliary diseases that include various congenital variants, post-cholecystectomy disorders, chronic pancreatitis, neoplastic duct obstruction and choledocholithiasis. Despite MRCP being a technique that constantly evolves, it still reached a developmental stage where its usefulness has been proven clinically which can be compared to the clinical accuracy of other conventional cholangiography techniques.

With further development, MRCP is believed to have the potential in replacing diagnostic ERCP as the main modality for imaging the pancreatic duct and biliary duct.[7]

According to Tripathi RP et al MRCP was found to have high sensitivity and specificity in detecting biliary abnormalities such as biliary dilatation, bile duct calculi, strictures and their anatomical variants. MRCP is a well-known non-invasive imaging investigation in diagnosing the pancreatic and biliary duct abnormalities. MRCP has now extremely improved in its diagnostic efficacy with its increased resolution and reliability to an extent that it can replace diagnostic ERCP.

The MRCP results were analyzed in patients with pancreatic and biliary ductal abnormalities, and these findings were compared with surgical findings or with the finding of ERCP.

There were 150 patients who had undergone MRCP by various techniques were evaluated. According to the reason for referral, the patients were classified into 4 groups. There were 65 patients with Obstructive jaundice, 25 patients with acute/chronic pancreatitis, 20 patients were screened prior to laparoscopic cholecystectomy were 20 whereas 40 patients had failed ERCP.

The results were favoring MRCP as it correctly identified the biliary obstruction level in 58 patients out of the total 61 patients. It was possible to characterize the nature of stricture whether it was benign or malignant in 30 patients out of 32 patients. Morphology of pancreatic duct was also assessed by MRCP duct in 13 out of 15 patients in whom ERCP has detected ductal changes.[8]

Dimitrios K Christodoulou at al opined that past fifteen years, ERCP has significantly emerged from entirely being a tool of diagnosis into a technique that is now being mainly used for therapeutic purpose.[9]

It was first used for biliary duct disorders and then subsequently was used for diagnosing pancreatic disorders. CT, MRCP, MRI and endoscopic ultrasonography gives a diagnosis in maximum number of people with pancreatic diseases and also helps patients and physicians to evade complications of ERCP.

However, pancreatic endotherapy may also be beneficial in a selected patients with pancreatic disorders so that they can avoid complex surgery and also prevents them from chronic medication use. Pancreatic cyst drainage, pancreatic sphincterotomy and pancreatic stenting have been proved to be some of the most challenging and effective endoscopic interventions. These procedures should be performed by well-trained and experienced therapeutic endoscopists taking extreme caution.

Huang LY et al assessed the application of ERCP in biliary ductal and pancreatic diseases. He included a total number of 2075 patients who underwent ERCP and their results were analyzed retrospectively. He also calculated the complications and the therapeutic effect of ERCP. In 64 cases, diagnostic ERCP was performed and the procedure was successful, in the remaining 2011 cases therapeutic ERCP was performed, and the success rate came up to 94.6%.

Complication rates were assessed which came up to 5.1% and the most common complication detected was acute pancreatitis. With these above findings, he came to a conclusion that ERCP can be considered as the major diagnostic and therapeutic tool for biliary ductal and pancreatic disease. Therapeutic ERCP has advantages like it is a minimally invasive procedure, safe and acts as an effective treatment method for biliary-pancreatic diseases.[10]

According to Ueno E MRCP accurately demonstrates the normal as well as pancreatic ductal abnormalities which also include the congenital anomalies of pancreatic duct and biliary tree.

MRCP was performed in 162 patients with pancreatic abnormalities which includes congenital anomalies of bile duct and pancreatic duct. ERCP was performed in 93 patients and their results were compared. Features such as visualizing the pancreatic duct and its branches, stenosis, filling defects and the presence or absence of ductal dilatation were documented.

They concluded by saying that when comparing MRCP with ERCP, MRCP overestimated the MPD stenosis, meanwhile it underestimated findings such as pancreatic duct filling defects in pancreatitis and dilatation of the branches.

However, it was found that MRCP was significantly more beneficial compared to ERCP in the diagnosing of conditions such as mucin-producing tumor of the pancreas and cystic lesions. Hence MRCP was proved to accurately diagnose the pancreatic duct abnormalities and also the congenital anomalies of the biliary tree and pancreatic duct.[11]

Vitellas KM et al in his study proved MRCP as an equally comparable investigation tool in diagnosing extrahepatic bile duct abnormalities when compared with invasive diagnostic endoscopic retrograde cholangio-pancreatography (ERCP).

In MRCP, calculi appears as dark filling defects in a hyperintense fluid background. Due to sclerosing cholangitis, bening structures appear as multifocal segments of dilatation and narrowing or bile ducts of normal-caliber, which produces a classic beaded appearance. Features such as bile duct dilatation and pancreatic duct dilatation in MRCP is highly in favor of malignancy of pancreatic head.

In cases of pseudocyst MRCP is considered more sensitive method than ERCP as only less than fifty percentage of pseudocysts get filled by the contrast material. In conditions such as biliary cystadenomas and cystadenocarcinomas, the secreted mucin produces partial obstruction of the passage and filling defects of contrast material in ERCP whereas MRCP significantly is more accurate in identifying these tumors and its extent.

In patients in whom biliary-enteric anastomoses is present, MRCP is considered to be the imaging investigation of choice in the evaluation of any patient with suspected pancreatico-biliary disease. Another significant MRCP's use, is its capability in demonstrating the abnormal anatomy of the bile duct before performing cholecystectomy. MRCP has also been found to be accurate in identification of pancreatic divisum.[12]

According to Albert JG et al after the introduction of endoscopic retrograde cholangio-pancreatography (ERCP) in the year 1970, gastroenterologists have acquired a vast spectrum of diagnostic and therapeutic options in the biliary ductal and pancreatic system. In present scenario MRCP has significantly replaced diagnostic ERCP and thereby it avoids complications which may occur in endoscopic technique.[13]

According to Angulo P et al MRCP is performed in patients with primary sclerosing cholangitis and biliary abnormalities. MRCP had a singnificant role in diagnosis. In this study, invasive cholangiography such as PTC or ERCP, and MRC were performed in 73 patients, among which there were 33 male patients, 40 female patients. Their mean age was calculated to be 56 years.

Out of the total study population of 73 patients, 42 patients had benign biliary disease, out of which 23 patients had primary sclerosing cholangitis; 9 patients were diagnosed with malignant biliary disease; and the remaining 22 patients had normal biliary ducts. MRC was obtained in 73/73 (100%), and invasive cholangiography (2 PTC's, 68 ERCP's) procedures in 70/73. Using findings of ERCP/PTC as the standard, MRC was assessed and diagnostic accuracy was found to be greater than 90% in the diagnosis of biliary ductal dilatation, bile duct stones, biliary obstruction, normal biliary tree and primary sclerosing cholangitis.

Therefore he proved MRC has significant diagnostic accuracy of 90% in diagnosing biliary abnormalities compared to the invasive cholangiography in which diagnostic accuracy came up to 97%. Thus the study concluded that MRC has extremely high diagnostic accuracy in diagnosing biliary abnormalities. Owing to the noninvasive nature of MRC, it is even more advantageous over the invasive cholangiography where the major intention of the procedure is to arrive at a diagnosis.[14]

In the study done by Rahman R et al, of 165 patients who underwent MRCP prior to ERCP the sensitivity and specificity of MRCP was calculated and was found that MRCP did not show satisfying result when compared with that of ERCP in diagnosing choledocholithiasis, biliary and pancreatic ductal dilatation or obstruction and periductal masses. MRCP showed 74.6% sensitivity and 83.5% specificity in detecting choledocholithiasis, 85.4% sensitivity and 87.4% specificity in detecting strictures, 85.9% sensitivity and 91.2% specificity in detecting obstruction, 92.4% sensitivity and 93.5% specificity in detecting ductal dilatation, and 90.8% sensitivity and 92.6% specificity in detecting periductal masses.

The study shows MRCP to have increased false negative results in case of choledocholithiasis and strictures and increased false positive results in case of ductal dilatation and periductal mass when compared with ERCP. Therefore, it cannot be used as a substitute, thereby ERCP remains the gold standard investigation for better visualization of the biliary tree and pancreatic duct.[15]

Magnetic resonance cholangiopancreatography was assessed by Liang C et al in patients with malignant obstructive jaundice. They proved the diagnostic efficacy in determining the location and extent of obstruction using MRCP was higher and the specificity was 82.9%.

Liang C, Mao H analyzed accuracy of MRCP in diagnosing malignant obstructive jaundice. The diagnostic accuracy of MRCP in malignant obstruction came up to 82.9%. Hence MRCP was proved to have high diagnostic specificity in identifying the location and also the extent of obstruction. They concluded saying that MRCP had significant role in diagnosing malignant obstructive jaundice.[16]

Miletić D et al in their study assessed that Magnetic resonance cholangiopancreatography (MRCP) had extremely high sensitivity and specificity in demonstrating the level and identifying the presence of biliary duct obstruction. One major weakness of MRCP is its inability to offer therapeutic interventions. Other significant advantage of MR cholangiography is that it can also be used for detecting the resectability of a malignant neoplasm such as hilar cholangiocarcinoma by assessing the proximal extent of disease where ERCP may not be successful.[17]

According to Soto JA et al Magnetic resonance cholangiography (MRC) is an efficient noninvasive diagnostic imaging modality which provides high-quality images of the biliary ducts. Factors such as sensitivity and specificity of the (3D FSE) Magnetic resonance cholangiography were assessed in the diagnosis of biliary tract abnormalities. Forty-six patients were referred for elective direct cholangiography out of which 45 patients underwent endoscopic retrograde cholangiopancreatography and 1patient underwent percutaneous transhepatic cholangiography.

Biliary ductal abnormalities such as presence of dilatation, strictures, and intraductal abnormalities were assessed. MRC was evaluated comparing with direct cholangiography as the gold standard and the sensitivity and specificity images were obtained in total number of 44 patients. Sensitivity for diagnosing biliary ductal dilatation (n = 27), bile duct strictures (n = 10), and intraductal pathologies (n = 7) were calculated and it was 96.3%, 90%, and 100%. In addition, MRC showed 16 of 17 patients with normal bile ducts (specificity, 94.1%). Therefore, they opined that MRC has extremely high sensitivity and specificity in evaluating the biliary tree. Based on this study, the efficiency of MRC using 3D FSE found to be sufficiently high to suggest it as a diagnostic imaging modality in evaluating biliary tract abnormalities.[18]

Eva C Kaltenthaler et al evaluated Magnetic resonance cholangiopancreatography (MRCP) and proved it to be an effective alternative diagnostic tool to endoscopic retrograde cholangiopancreatography (ERCP) for identifying biliary obstruction.

They reviewed 25 studies reporting several conditions, including malignancy (4 studies), choledocholithiasis (18studies), stricture (2 studies) and dilatation (5 studies) obstruction (3 studies). Three of the 18 studies reported with choledocholithiasis were removed from the analysis due to inadequate data, or study design differences.

The sensitivity was calculated for the 15 studies of choledocholithiasis and it ranged from 0.50 to 1.00 while specificity which was calculated to range from 0.83 to 1.00. Significant heterogeneity was found across the 15 studies so the sensitivities and specificities and the results were summarized by a Receiver Operating Characteristic (ROC) curve. The sensitivity was calculated and it ranged from 0.81 to 0.94 and specificity ranged from 0.92 to 1.00 for malignancy.[19]

Vanicek J, Kyselova H et al assessed MRCP and ERCP in diagnosis of choledocholithiasis. All patients underwent MRCP followed by ERCP. They found sensitivity, specificity and diagnostic accuracy of MRCP was lower in their study when compared to the ERCP (92%, 91% or 93 %). They concluded saying complications following ERCP is more, therefore MRCP is considered in spite of its lower sensitivity as the investigation of choice in the diagnosis of choledocholithiasis by means of noninvasive methods.[20]

According to a study done by Norero E et al MRCP has a higher accuracy in diagnosing choledocholithiasis. Retrospective review of patients with suspected choledocholithiasis were studied with MRCP and other confirmatory test such as ERCP, surgical common bile duct exploration or transcystic cholangiography. 125 patients were included in the study. According to their study sensitivity was found to be 97%, specificity 74% positive predictive value 89%, negative predictive value 90% and hence the accuracy of MRCP was 90% for the diagnosis of choledocholithiasis.[21]

Miao L et al evaluated diagnostic value of ultrasonography, MRCP and ERCP in common duct stones. 384 patients with suspected common duct stones underwent abdominal ultrasonography, MRCP and ERCP were included in the study. There was stone in common duct in 370 patients and no stones in 14 of 384 patients. US detected stones in 268 cases, with 8 false positive results. MRCP diagnosed stones in 362 cases and false positive result in 6 cases, ERCP diagnosed stones in 370 cases. The diagnostic accuracy of US, MRCP and ERCP was 70.3% (260/370), 96.2% (356/370) and 100%.[22]

Hekimoglu K et al assessed the diagnostic efficacy of few new MR sequences in MRCP and its comparison with ERCP along with review of current literatures. A total number of two hundred and sixty nine patients were included in this study. Among the 269 patients, there were 25 males and 145 females, whose mean age ranges from 23-92. The MRCP procedure was performed before the ERCP in all cases. All MRCP studies were performed with new MR technique using a heavily T2-weighted turbo spin echo (TSE) sequence.

The TSE sequence is one of the most widely used multiplanar 3-D MR technique currently, has high spatial resolution and fast imaging capacity. The study participants were divided into four main groups; group I consist of normal, group II includes stone disease, group III includes tumor and others into group IV. Group I comprises of 228 patients who had a normal pancreatic duct and biliary tree on both the investigations MRCP and ERCP.

There were totally 18 patients in group II, for whom the MRCP sensitivity and specificity was calculated which came up to 88.9% and 100% for diagnosing biliary stone disease. It was found that the positive predictive value (PPV) was 100%, the negative predictive value (NPV) was 99.2% and accuracy 99.2%. MRCP had sensitivity of 100% and specificity of 100% for the 20 patients who were in group III. Its PPV was 100%, NPV was 100% and accuracy was 100%.[23]

According to Halefoglu AM et al MRCP has a much lower complication rate when compared to ERCP. As already proved ERCP is considered as the gold standard investigation for biliary tract imaging but is less invasive and is also associated with complications.[24]

Howard K et al assessed MRCP's value in diagnosing biliary abnormalities in post cholecystectomy patients. According to their study, MRCP's accuracy is comparable to ERCP. MRCP was found to be effective and also cost-effective when compared to ERCP, especially in patients for whom the suspected disease prevalence is low, thereby avoiding further intervention.

The results of their study proved that MRCP was dominant over ERCP. The results showed that, there was 59% likelihood that MRCP was cost saving for whom there is a low to moderate probability of common bile duct stones. It was seen that, with a higher adjusted quality survival, there was 83% chance of MRCP being more effective and it also had a better cost-effectiveness ratio.[25]

According to H Adamek et al, MRCP is as sensitive as ERCP in assessment biliary tract diseases. MRCP images were gathered for 60 patients. There were thirteen patients who had a normal bile duct. Sensitivity and specificity were calculated and for the detection of any abnormality it was 89% and 92%, and for diagnosing malignancy it came up to 81% and 100%. These results calculated and were equivalent to ERCP (91% and 92% for any abnormality, and 93% and 94% for malignant diseases).[26]

According to Adamek HE et al, MRCP and ERCP have similar sensitivity in pancreatic carcinoma detection. In cases of suspected pancreatic carcinomas MRCP has the potential to prevent unnecessary common bile duct and pancreatic duct explorations, where it is highly unlikely to perform interventional endoscopic therapy. A total of 124 patients constituted the study.

Of the 124 patients, pancreatic carcinomas were detected in 30% of patients, chronic pancreatitis was found in 46% patients, neoplastic pancreatic diseases were seen in 14%, clear pancreatic ducts were seen in 10% of the study population. In diagnosing pancreatic cancer, MRCP's sensitivity was 84% along with a specificity of 97%. The sensitivity of ERCP was 70% and specificity was found to be 94%.[27]

Hintze RE et al evaluated clinical importance of MRCP compared to ERCP. A total of 78 patients were prospectively followed up with ERCP and MRCP for a duration of twelve months. On a blinded basis, the images were interpreted by two radiologists. Features such as dilatations, intraductal abnormalities and strictures were documented and clinical correlation of diagnosis was made.

Among the 78 patients included in the study, images from MRCP was collected for 76 patients. The sensitivity of MRCP in detecting normal bile ducts was found to be 71%, bile duct dilatation was 83%, and stricture was 85%, correct stricture location in 77% and bile duct calculi was 80%. The positive predictive value of MRCP for normal bile ducts was 62%, bile duct dilatation was 91%, strictures was 100%, correct stricture location was 91% and bile duct calculi was 100%.

The MRCP's sensitivity in detecting benign strictures was 50% and malignant strictures 80%. The sensitivity of MRCP in normal pancreatic ducts recognition was 33%, dilation was 62%, strictures was 76% and correct location was 66%, benign strictures was 87% and malignant strictures was 60% and for pancreatic duct stones it was 60%. The positive predictive values of MRCP normal pancreatic ducts recognition was 50%, dilation was 100%, strictures was 87% and correct location was 100%, benign strictures was 87% and malignant strictures was 75% and for pancreatic duct stones it was 100%. Thus he concluded that MRCP is equivalent to ERCP in terms of contributing diagnostic information in many patients. Whenever inadequate results are obtained in established techniques, it is necessary for MRCP to be used.[28]

Siddique K et al assessed a prospective study with 60 patients. The history, physical examination and other investigations like ERCP, MRCP, USG abdomen, CT-Scan and histopathology were analyzed. Out of those 60 patients, 40 were male and 20 were female. Malignant obstructive jaundice was seen in 34 patients while 26 had benign etiology. Commonest causes for benign and malignant obstructive jaundice were found. Commonest malignancy was Carcinoma of the pancreatic head 18/60 (30%) followed by Carcinoma gall bladder 8/60 (13.33%), cholangiocarcinoma 7/60 (11.66%), and periampullary carcinoma 1/60 (1.66%). Choledocholithiasis 21/60 (35%) was the commonest benign cause followed by stricture of common bile duct 3/60 (5%) and acute pancreatitis 2/60 (3.33%).[29]

He concluded saying obstructive jaundice is common amongst females and the cause is mostly malignant. Commonest malignancy was Carcinoma of the pancreatic head while commonest benign cause is the choledocholithiasis. Ultrasound, CT-Scan and ERCP are important imaging diagnostic modalities for evaluating patients with obstructive jaundice. ERCP has the additional therapeutic advantage.

Mosler P et al assessed the diagnostic accuracy of mangnetic resonance cholangiopancreaticography in identifying pancreatic divisum. ERCP is considered as gold standard method in the diagnosis of pancreas divisum. They assessed patients who had undergone both the investigations of ERCP and MRCP. Pancreas divisum was detected by ERCP in 19 patients out of the total 113 patients, whereas the same was detected in 14 patients by MRCP. MRCP was also found to have provide three false positive results.

Thus MRCP had 73.3% sensitivity, 96.8% specificity, and 82.4% positive predictive value, 94.8% was its negative predictive value. The sensitivity of MRCP in diagnosing pancreas divisum was around 73.3% which is comparatively lesser, as previous studies had reported MRCP's sensitivity to be as high as 100%.[30]

Pasanen PA et al evaluated ultrasound, ERCP and CT in assessing causes of benign and malignant jaundice and cholestasis. Choledocholithiasis (n = 83) was the most common benign disease was and carcinoma of pancreas (n = 33) was the most common malignant disease. The extrahepatic obstruction and its benign nature was correctly identified by CT, US and ERCP in 53%, 53%, and 90% of patients, and choledocholithiasis were correctly diagnosed in22%, 25%, and 79%. Malignant extrahepatic obstruction was exactly diagnosed in 57%, 80%, and 83% and in case of pancreatic cancer the values were 60%, 97%, and

89%. The results prove that the 3 methods of imaging are complementary to each other.[31]

In the study "A prospective comparison of magnetic resonance cholangiopancreatography with endoscopic retrograde cholangiopancreatography in the evaluation of patients with suspected biliary tract disease "conducted by Varghese JC, Farrell MA, Courtney G et 100 patients underwent MRCP, in whom direct cholangiographic correlation such as ERCP, n = 98; PTC, n = 9; intraoperative cholangiography, n = 3 was used for comparison.

The MRCP examinations were performed using a two-dimensional multi-slice, fast spin echo (FSE) technique and a local surface coil. Using direct cholangiography choledocholithiasis was diagnosed in 30 patients, benign and malignant strictures diagnosed in 28 patients and normal biliary duct in 42 patients. The benign strictures, n = 2; tumor, n = 18; lymphnode recurrence, n = 3; unknown histology, n = 5 was evaluated by one or more of the following investigations: surgery (n = 8), biopsy (n = 15), cytology (n = 6) and cross-sectional imaging/follow-up findings (n = 3).

This study showed MRCP diagnosed choledocholithiasis with a sensitivity of 93%, specificity of 99% and accuracy of 97 %. Results showed two false-negative and one false-positive when compared with the direct cholangiography. Thus MRCP was found to accurately diagnose the presence and the level of strictures in all patients. The overall sensitivity, specificity and accuracy of MRCP in diagnosing biliary duct lesions were 97%, 98% and 97%. Therefore, according to this study MRCP has significantly high diagnostic accuracy when compared with direct cholangiography in the detection of bile duct disease.[32]

OBSERVATION AND RESULTS

RESULTS

The results of the study are computed and tabulated below.

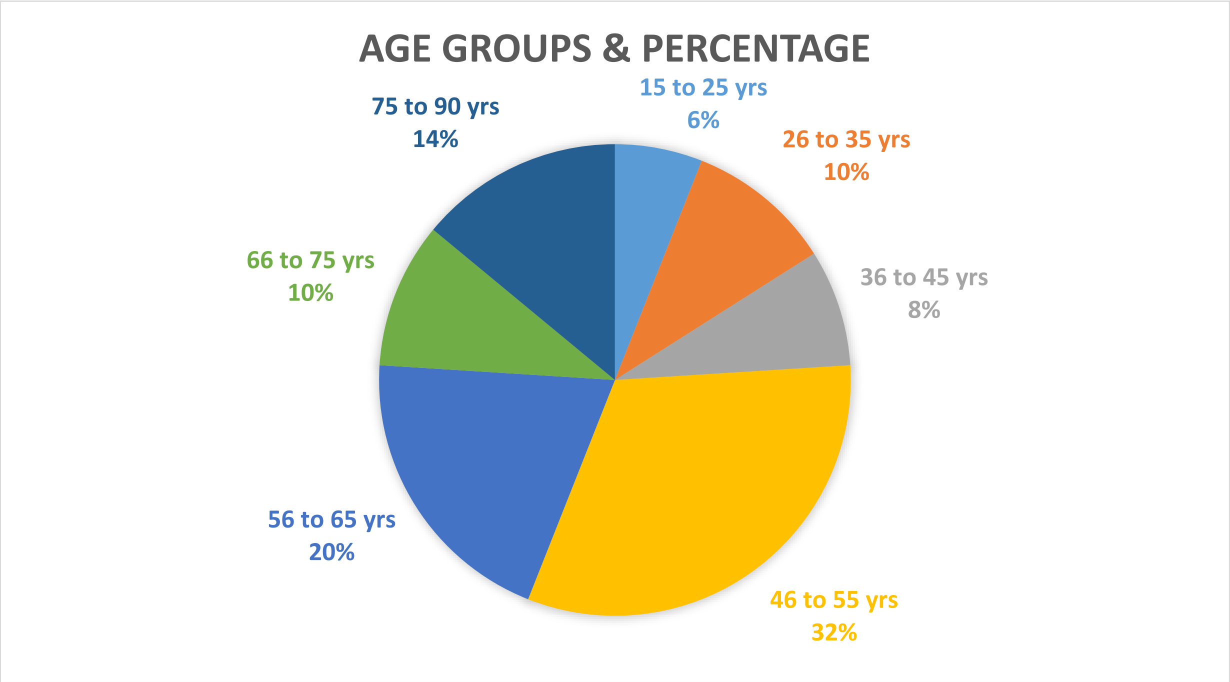
I. AGE

Table no 2 showing the age distribution of the study population.

AGE GROUPS (in years)	FREQUENCY	PERCENTAGE (%)
15 to 25	3	6
26 to 35	5	10
36 to 45	4	8
46 to 55	16	32
56 to 65	10	20
66 to 75	5	10
75 to 90	7	14
Total	**50**	**100**

The above table shows that, out of the total study population, the majority belonged to the 46 to 55 years age group amounting to 32%. The least belonged to the 15 to 25 years age group with 6%.

Figure no 4: Age groups & Percentage.



The above pie chart shows the percentage of the study population according to age group.

Figure no 5: Age groups & Frequency.

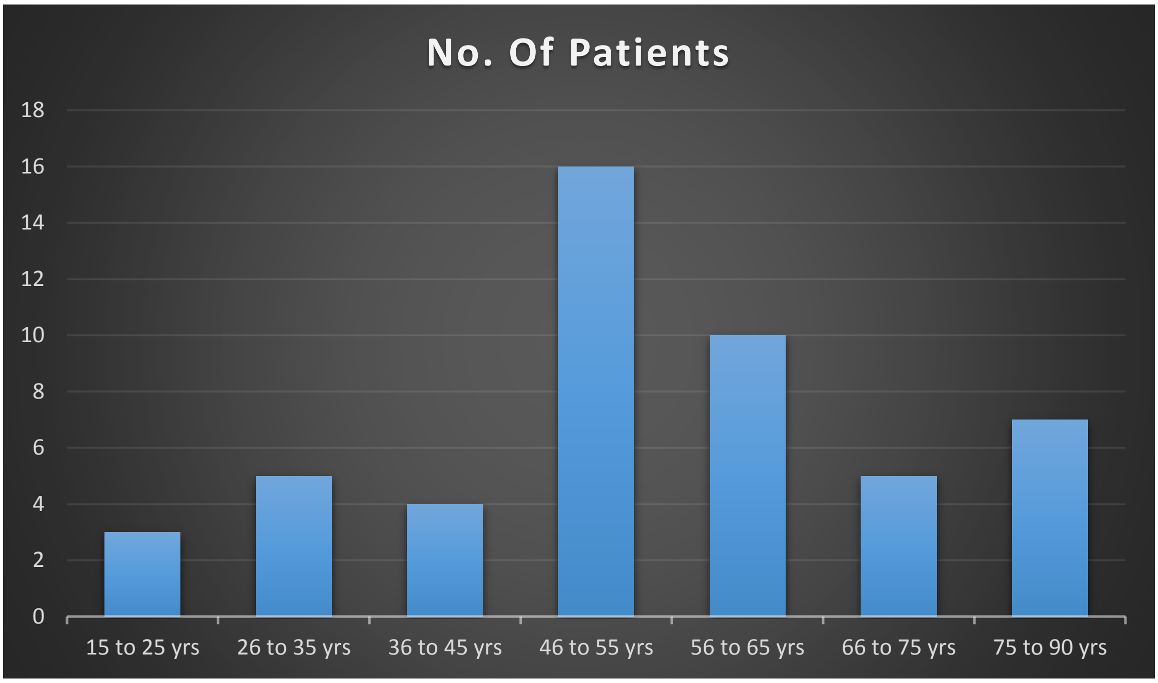


Figure no 5 is a histogram showing age in groups and the number of patients in the study population.

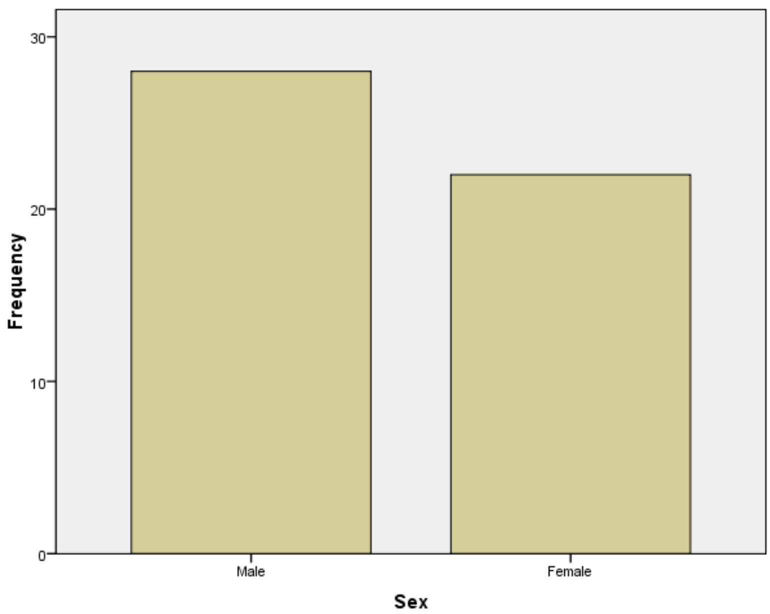
II. SEX

Table no 3: Gender distribution.

SEX	FREQUENCY	PERCENT
Male	28	56
Female	22	44
Total	**50**	**100**

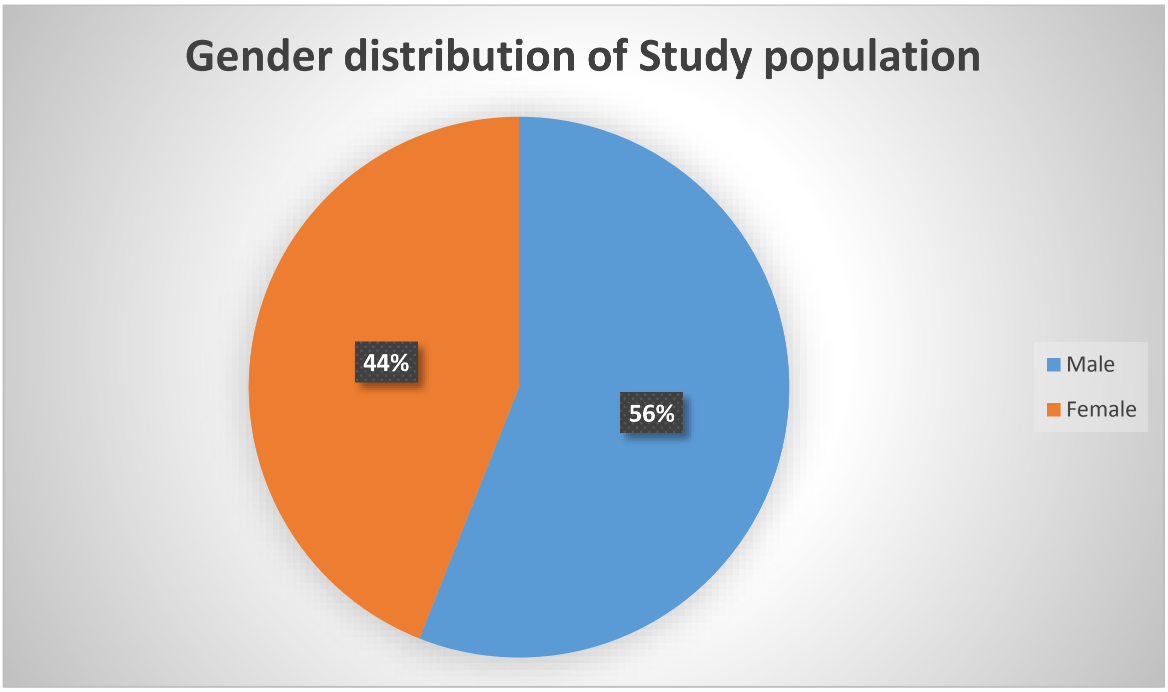
The above table shows that 56% of the study population were Males, and 44% were females.

Figure no 6: Sex of study population.



The above histogram shows the number of persons according to gender.

Figure no 7: Gender & percentage.



The above pie chart shows the percentage of the study population, with 44% being males and 56% being females.

III. PATHOLOGY DETECTED IN STUDY POPULATION.

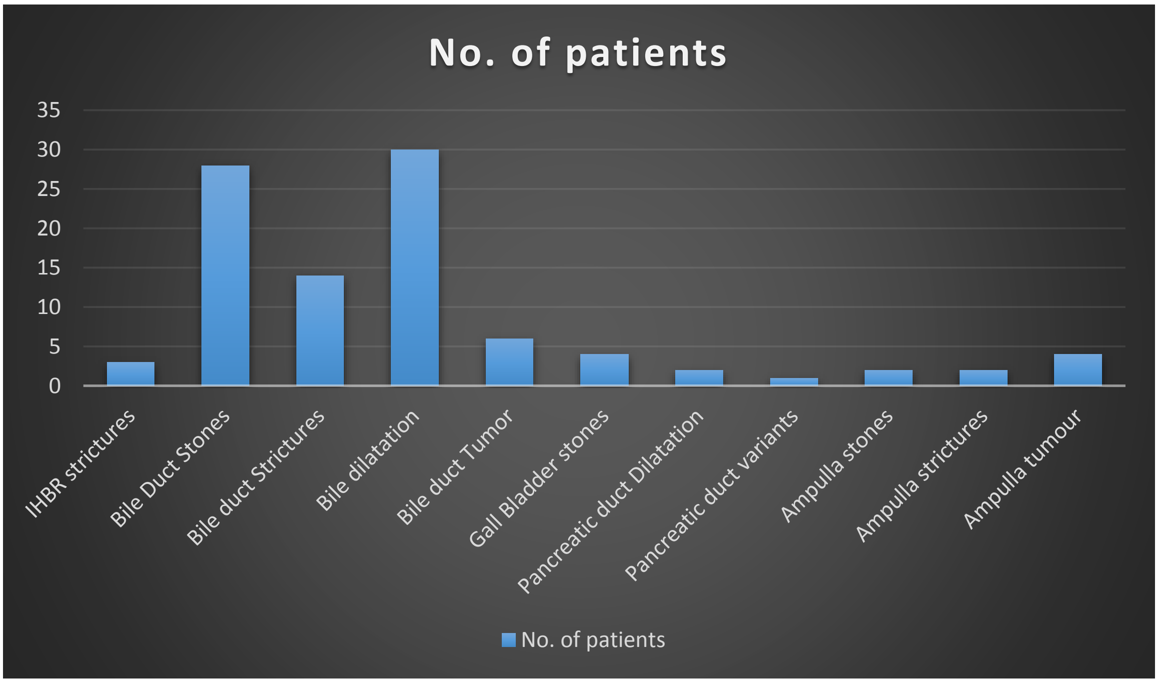
Table no 4: Pathologies detected.

S.NO	PATHOLOGY	FREQUENCY	PERCENTAGE
1	IHBR strictures	3	6
2	Bile Duct Stones	28	56
3	Common Bile duct Strictures	14	28
4	Bile duct dilatation	30	60
5	Bile duct Tumor	6	12
6	Gall Bladder stones	4	6
7	Pancreatic duct Dilatation	2	4
8	Pancreatic duct variants	1	2
9	Ampulla stones	2	4
10	Ampulla strictures	2	4
11	Ampulla tumor	4	8

The above table shows the frequency and percentage of the various pathologies detected among the study population.

The abnormalities thus detected were divided into, those involving intrahepatic biliary radicals, the CBD, the ampulla and of pancreatic duct.

Figure no 8: Frequency of pathologies detected.



The above histogram shows the number of patients in which pathologies were detected in the study population.

IV. IHBR STRICTURES

Table no 5 showing frequency and percentage of IHBR strictures

PARAMETER	FREQUENCY	PERCENTAGE (%)
No IHBR stricture	47	94
ERCP & MRCP	3	6
Total	**50**	**100**

The above table shows that out of the total study population, 6% had IHBR strictures, which were diagnosed by both ERCP and MRCP and was later confirmed by Histopathological examination.

Table no 6: Diagnostic efficacy of MRCP for IHBR strictures

	SENSITIVITY (%)	**SPECIFICITY (%)**	**POSITIVE PREDICTIVE VALUE (%)**	**NEGATIVE PREDICTIVE VALUE (%)**
MRCP	100	100	100	100
ERCP	100	100	100	100

The above table shows that both MRCP and Histopathology has sensitivity and specificity of 100% each, whereas ERCP also had 100% sensitivity and 100% specificity in detecting IHBR strictures.

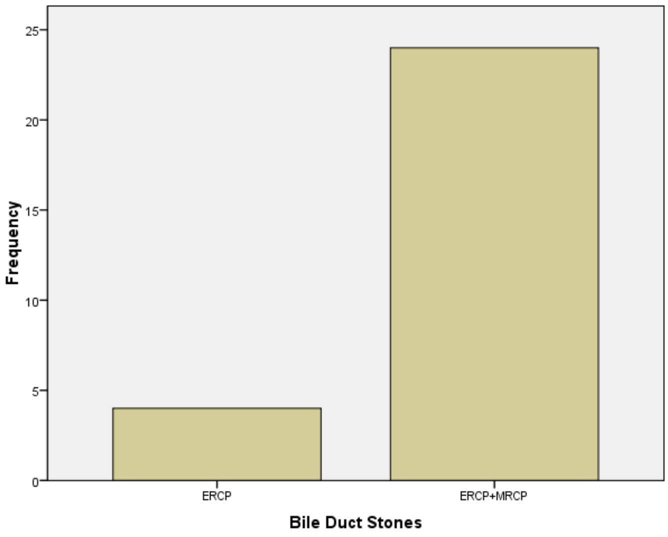
V. BILE DUCT STONES

Table no 7: Frequency and percentage of Bile Duct Stones.

PARAMETER	FREQUENCY	PERCENTAGE (%)
No bile duct stones	21	42
ERCP	5	10
ERCP & MRCP	24	48
Total	**50**	**100**

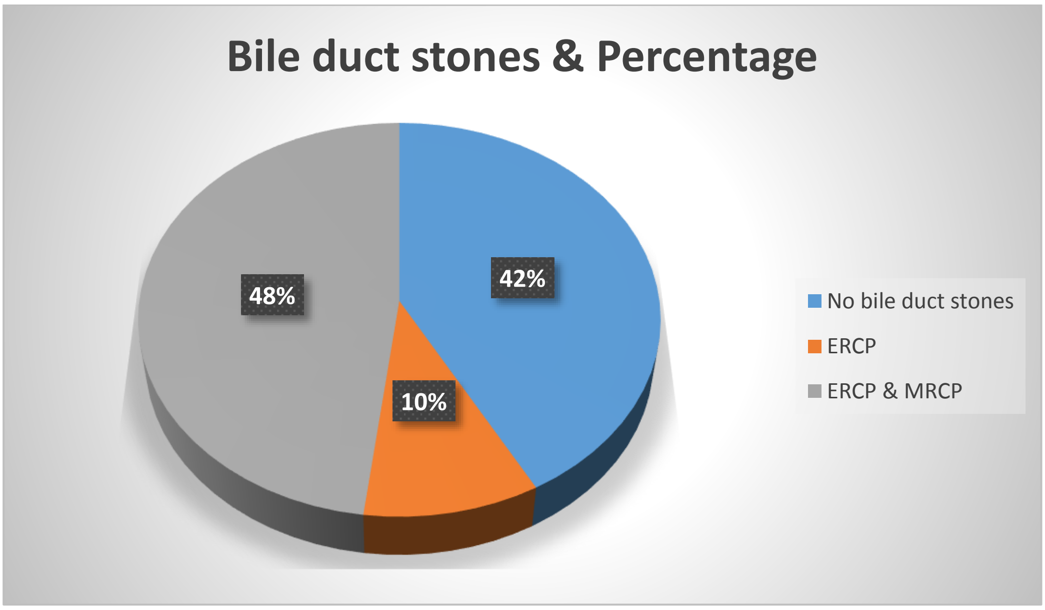
From the above table, it is observed that MRCP detected bile duct stones in 48% of the study population along with ERCP. ERCP alone detected bile duct stones in 10%.

Figure no. 9: Bile duct stones and its frequency



The above histogram shows the frequency of bile duct stones detected with ERCP and ERCP with MRCP.

Figure no. 10: Bile duct stones & percentage.



The above pie chart shows the percentage of bile duct stones detected by ERCP and MRCP.

Table no 8: Diagnostic efficacy of MRCP and ERCP for Bile Duct Stones

	SENSITIVITY (%)	**SPECIFICITY (%)**	**POSITIVE PREDICTIVE VALUE (%)**	**NEGATIVE PREDICTIVE VALUE (%)**
MRCP	87.5	100	100	84.6
ERCP	100	100	100	100

In detecting Bile duct stones, it is observed that MRCP has sensitivity and specificity of 87.5% and 100% respectively. Sensitivity and specificity of ERCP is 100% each.

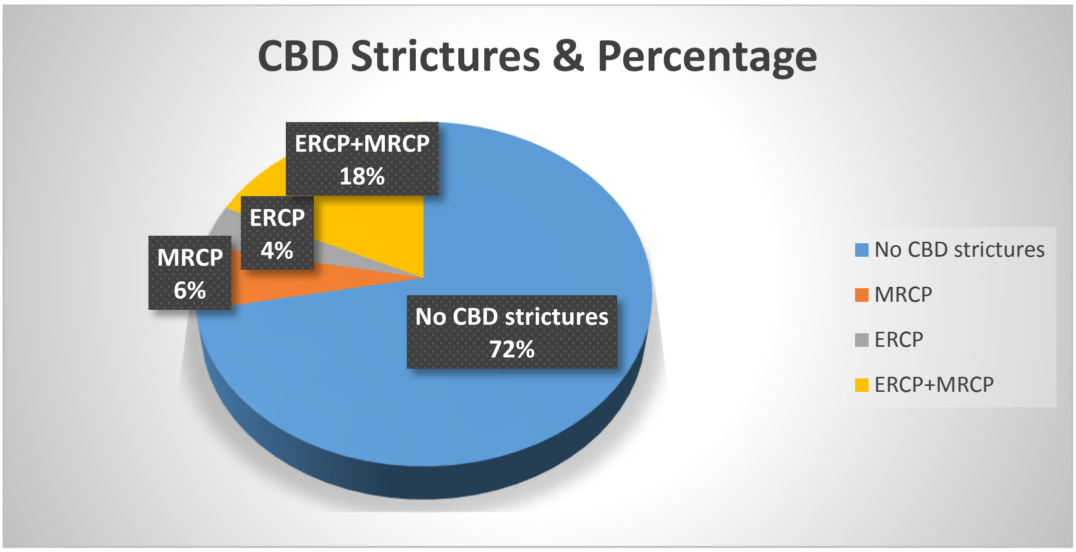
VI. COMMON BILE DUCT STRICTURES

Table no 9: Frequency and percentage of Common bile duct Strictures

PARAMETER	FREQUENCY	PERCENTAGE (%)
No CBD strictures	36	72
MRCP	3	6
ERCP	2	4
ERCP+MRCP	9	18
Total	**50**	**100**

ERCP detected bile duct strictures in a total of 11 patients out of which MRCP detected CBD strictures in 9 patients. MRCP alone detected CBD strictures in 3 patients which were false positive.

Figure no. 11: CBD strictures and percentage.



The above pie chart shows the percentage of CBD strictures detected by ERCP, MRCP and ERCP+MRCP. ERCP alone detected 4%; MRCP detected 6% of the study population. ERCP+MRCP detected BCD strictures in 18% of the study population.

Table no 10: Diagnostic efficacy of MRCP, ERCP for Common bile duct Strictures

	SENSITIVITY (%)	**SPECIFICITY (%)**	**POSITIVE PREDICTIVE VALUE (%)**	**NEGATIVE PREDICTIVE VALUE (%)**
MRCP	84.6	92.3	78.5	94.7
ERCP	100	100	100	100

In detecting common bile duct strictures, the sensitivity of MRCP was 84% and specificity was 92%.

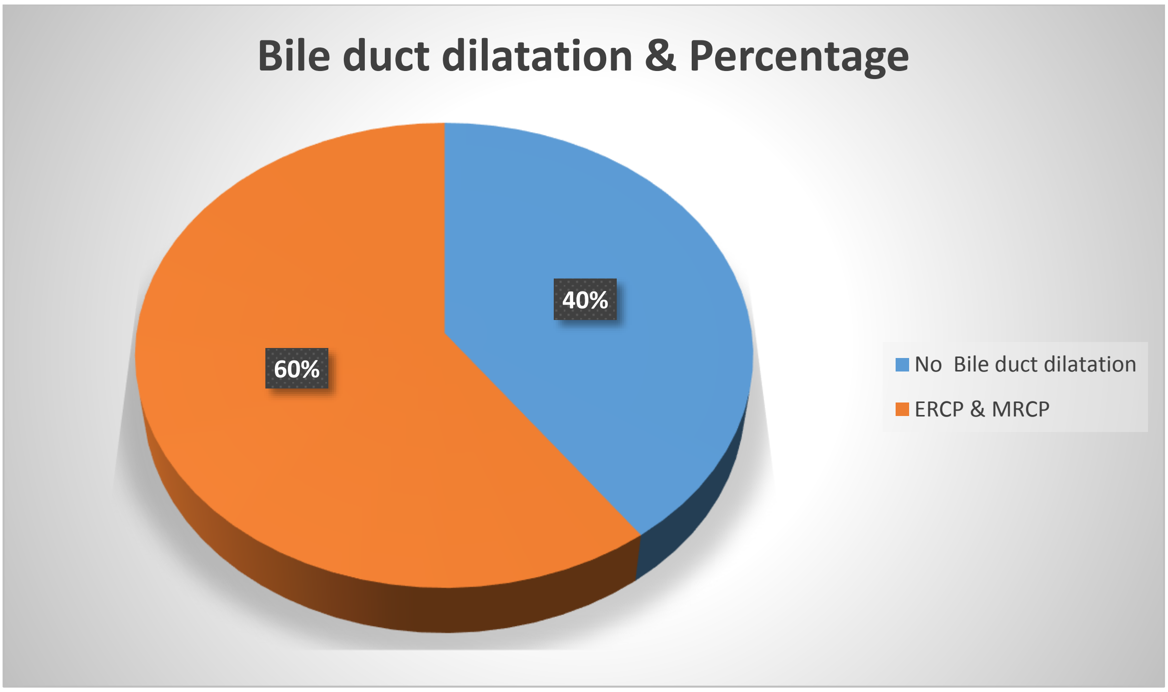
VII. BILE DUCT DILATATION

Table no 11: Frequency and percentage of Bile duct dilatation

PARAMETER	FREQUENCY	PERCENTAGE (%)
No Bile duct dilatation	20	40
ERCP & MRCP	30	60
Total	50	100

Above table shows that out of 50 patients ERCP and MRCP together detected bile duct dilatation in 30 patients.

Figure no. 12: Bile duct dilatation & percentage.



The above pie chart describes bile duct dilation detected by ERCP+MRCP.

Table No 12: Diagnostic efficacy of MRCP, ERCP for Bile duct Dilatation

	SENSITIVITY (%)	**SPECIFICITY (%)**	**POSITIVE PREDICTIVE VALUE (%)**	**NEGATIVE PREDICTIVE VALUE (%)**
MRCP	100	100	100	100
ERCP	100	100	100	100

In detecting bile duct dilatation, both MRCP and ERCP had 100% sensitivity and specificity.

VIII. COMMON BILE DUCT TUMOR

Table no: 13: Frequency and percentage of Common bile duct Tumor

PARAMETER	FREQUENCY	PERCENTAGE (%)
No CBD tumors	44	88
ERCP+MRCP	6	12
Total	50	100

Above table shows out of 50 patients ERCP and MRCP together detected CBD tumors in 6 patients.

Table no: 14 Diagnostic efficacy of MRCP, ERCP for Common bile duct tumor

	SENSITIVITY (%)	**SPECIFICITY (%)**	**POSITIVE PREDICTIVE VALUE (%)**	**NEGATIVE PREDICTIVE VALUE (%)**
MRCP	100	100	100	100
ERCP	100	100	100	100

The above table shows that MRCP and ERCP both had 100% efficacy in detecting common bile duct tumors.

IX. GALL BLADDER STONES

Table no 15: Frequency and percentage of Gall Bladder stones

PARAMETER	FREQUENCY	PERCENTAGE (%)
Nil pathology	47	94
MRCP	1	2
ERCP+MRCP	2	4
Total	50	100

It can be observed that gall bladder stones were detected in one patient by MRCP alone and in two patients by ERCP and MRCP.

Figure no. 13: Gall bladder stones and frequency

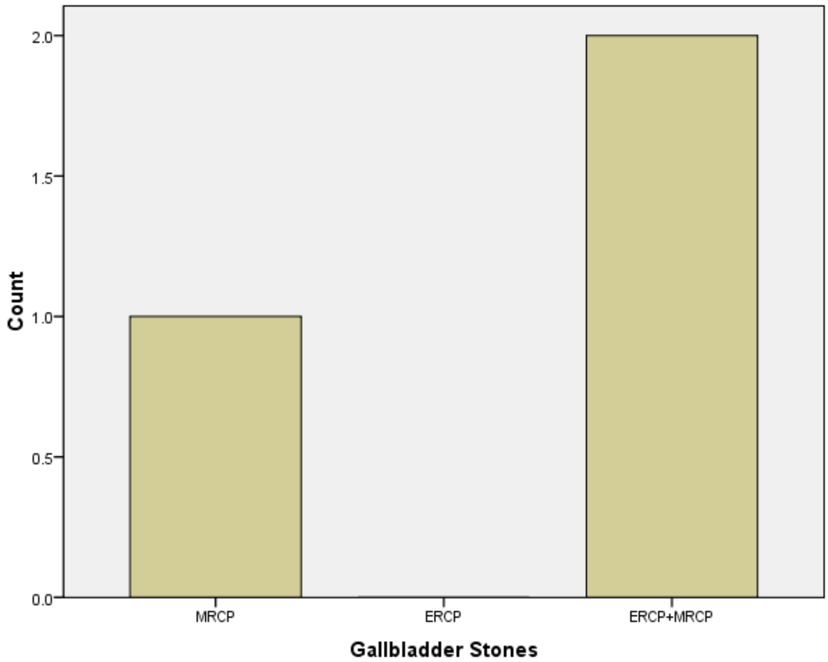


Figure no 13 is a histogram showing the no of patients detected by MRCP in one patient and ERCP+MRCP in two other patients out of the total of 50 in the study population.

Table no 16: Diagnostic efficacy of MRCP, ERCP for Gall bladder stones

	SENSITIVITY (%)	**SPECIFICITY (%)**	**POSITIVE PREDICTIVE VALUE (%)**	**NEGATIVE PREDICTIVE VALUE (%)**
MRCP	100	97.9	66.6	100
ERCP	100	100	100	100

Above table shows that sensitivity and specificity of MRCP was 100% and 97.9%.

X. PANCREATIC DUCT DILATATION

Table no 17: Frequency and percentage of Pancreatic duct Dilatation

PARAMETER	FREQUENCY	PERCENTAGE (%)
Nil pathology	48	96
MRCP	1	2
ERCP+MRCP	1	2
Total	50	100

MRCP had detected pancreatic duct dilatation in one patient, whereas ERCP and MRCP; both were found to be positive for pancreatic ductal dilatation in another patient.

Table no 18: Diagnostic efficacy of MRCP, ERCP for Pancreatic duct dilatation

	SENSITIVITY (%)	**SPECIFICITY (%)**	**POSITIVE PREDICTIVE VALUE (%)**	**NEGATIVE PREDICTIVE VALUE (%)**
MRCP	100	97.9	50	100
ERCP	100	100	100	100

In detecting pancreatic duct dilatation MRCP had a sensitivity and specificity of 100% and 97.9%. ERCP had a sensitivity and specificity of 100% each.

XI. PANCREATIC DUCT VARIANTS

Table no. 19: Frequency and percentage of Pancreatic duct variants

PARAMETER	FREQUENCY	PERCENTAGE (%)
Nil pathology	49	98
MRCP	1	2
ERCP	0	0
Total	50	100

Pancreatic duct variant was detected in one patient by MRCP. ERCP did not detect any variant of pancreatic duct.

Table no 20: Diagnostic efficacy of MRCP, ERCP for Pancreatic duct variants

	SENSITIVITY (%)	**SPECIFICITY (%)**	**POSITIVE PREDICTIVE VALUE (%)**	**NEGATIVE PREDICTIVE VALUE (%)**
MRCP	0	98	0	100

Sensitivity and specificity for MRCP in detecting pancreatic duct variant was zero and 98% respectively. Pancreatic duct variants were not detected by ERCP or histopathology, making the patient detected by MRCP to be false positive.

XII. AMPULLA STONES

Table no 21: Frequency and percentage of Ampulla stones

PARAMETER	FREQUENCY	PERCENTAGE (%)
Nil pathology	48	96
MRCP	1	2
ERCP+MRCP	1	2
Total	50	100

The above table shows that ampulla stones were detected by MRCP in one patient. ERCP and MRCP both had detected ampulla stones in another patient.

Table no 22: Diagnostic efficacy of MRCP, ERCP for Ampulla stones

	SENSITIVITY (%)	SPECIFICITY (%)	POSITIVE PREDICTIVE VALUE (%)	NEGATIVE PREDICTIVE VALUE (%)
MRCP	100	97.9	50	100
ERCP	100	100	100	100

The sensitivity and specificity of MRCP in detecting ampulla stones is 100% and 97% respectively. ERCP had a sensitivity and specificity of 100% each.

XIII. AMPULLA STRICTURES

Table no 23: Frequency and percentage of Ampulla strictures

PARAMETER	**FREQUENCY**	**PERCENTAGE (%)**
Nil pathology	48	96
MRCP	1	2
ERCP	1	2
Total	50	100

The above table shows that ampulla strictures were detected by MRCP and ERCP in one patient each.

Table no 24: Diagnostic efficacy of MRCP, ERCP for Ampulla strictures

	SENSITIVITY (%)	**SPECIFICITY (%)**	**POSITIVE PREDICTIVE VALUE (%)**	**NEGATIVE PREDICTIVE VALUE (%)**
MRCP	0	97.9	0	97.9
ERCP	100	100	100	100

The sensitivity and specificity of MRCP for detecting ampulla strictures was zero and 97% respectively. ERCP had a sensitivity and specificity of 100% each.

XIV. AMPULLA TUMOR

Table no 25: Frequency and percentage of Ampulla tumor

PARAMETER	FREQUENCY	PERCENTAGE (%)
Nil pathology	46	92
ERCP	1	2
MRCP	1	2
MRCP + Histopathology	1	2
ERCP + Histopathology	1	2
Total	50	100

The above table shows that ampulla tumor was detected in one patient each by MRCP and ERCP however was not confirmed by histopathology. MRCP and ERCP detected in one patient each, which was confirmed to be positive by histopathological examination.

Table no 26: Diagnostic efficacy of MRCP, ERCP for Ampulla tumors

PARAMETER	SENSITIVITY (%)	SPECIFICITY (%)	POSITIVE PREDICTIVE VALUE (%)	NEGATIVE PREDICTIVE VALUE (%)
MRCP	50	97.9	50	97.9
ERCP	50	97.9	50	97.9
Histopathology	100	100	100	100

The above table shows that the sensitivity and specificity of MRCP in detecting ampulla tumors was 50% and 97% respectively. ERCP had a sensitivity and specificity of 50% and 97% respectively. Histopathology is the gold standard, with sensitivity and specificity of 100% each.

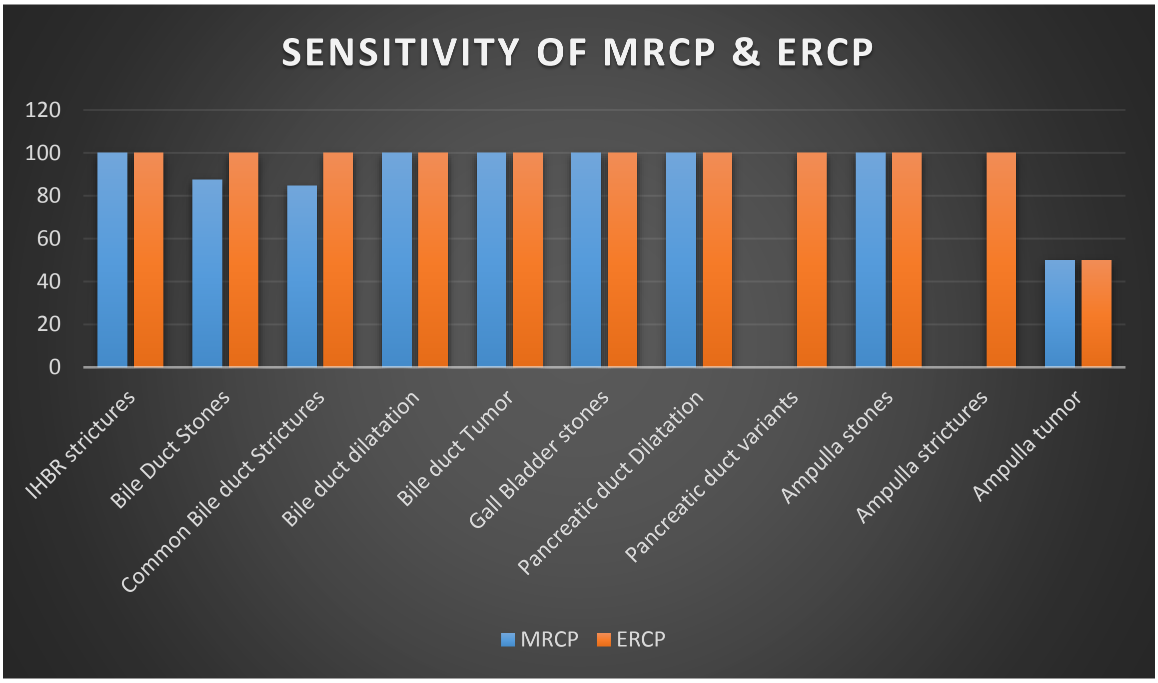
XV. SUMMARY OF SENSITIVITY AND SPECIFICITY

Table no 27: Summary of Diagnostic efficacy for various pathologies.

PARAMETER	**MRCP**		**ERCP**		**Histopathology**	
	Sensitivity (%)	**Specificity (%)**	**Sensitivity (%)**	**Specificity (%)**	**Sensitivity (%)**	**Specificity (%)**
IHBR						
Strictures	100	100	100	100	100	100
	Bile Duct					
Stones	87.5	100	100	100		
Strictures	84.6	92.3	100	100		
Dilatation	100	100	100	100		
Tumour	100	100	100	100	100	100
Gall Bladder						
Stones	100	97.9	100	100		
Pancreatic Duct						
Dilatation	100	97.9	100	100		
Variants	0	98				
Ampulla						
Stones	100	97.9	100	100		
Strictures	0	97.9	100	100		
Tumour	50	97.9	50	97.9	100	100

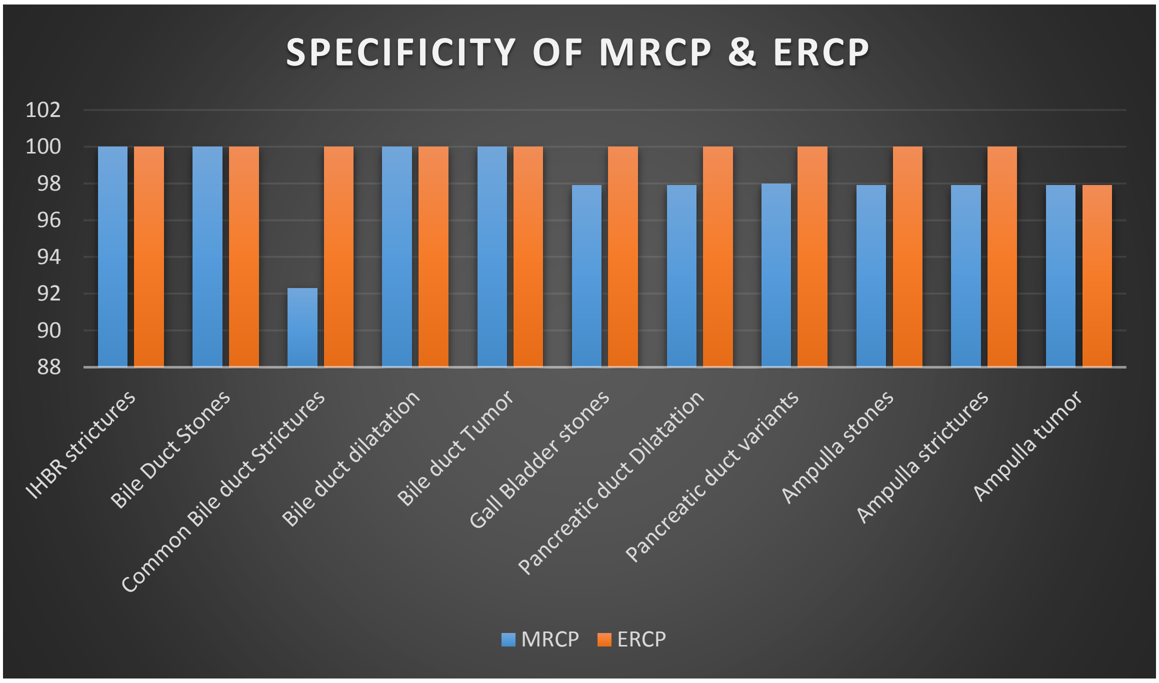
The above table shows sensitivity and specificity of ERCP, MRCP and Histopathology in detecting various pathologies.

Figure no. 14: Sensitivity of MRCP & ERCP



The above histogram shows the sensitivity of MRCP and ERCP for various pathologies

Figure no. 15: Specificity of MRCP and ERCP



The above histogram shows the specificity of MRCP and ERCP in detecting various pathologies shown above.

DISCUSSION

DISCUSSION

The aim of our study was to assess the diagnostic efficacy of MRCP as a diagnostic imaging modality, compared to invasive ERCP in the diagnosis of bile duct abnormalities, using specificity, sensitivity and positive and negative predictive values. If the results favor MRCP then diagnostic ERCP could be completely avoided and MRCP can be used as the investigation of choice for diagnosing biliary abnormalities while ERCP shall be reserved only for therapeutic purpose solely.

MRCP was introduced in the year 1991 as a non-invasive and a safe alternative to diagnostic ERCP/PTC in imaging of biliary ducts. Ever since then its technique has been refined, spatial resolution improved and time required reduced, to the point where it is considered at par with ERCP. Currently most centers use 3-Dimensional fat saturated heavily T2 weighted images in two planes and thick slab images. The use of 3D imaging has revolutionized MRC. Smallest of the stones (up to 4mm), and even the most subtle strictures can easily be picked up which were considered a limitation in thick slab images. Now as both sequences are routinely acquired the sensitivity and specificity of technique has improved. Now, the only major drawback of MRCP is lack of therapeutic option.

Most surgeons today would refer patients for MRCP if in doubt about the presence or absence of CBD stones on USG abdomen, when malignancy is a consideration, when ERCP is contraindicated or unsuccessful or when previous surgery such as biliary enteric anastamosis precludes ERCP. Though ERCP is considered the gold standard due to its high accuracy rate and its therapeutic value it can still be avoided for diagnostic purpose owing to its complications and operator dependency factors. MRCP has a few advantages over ERCP ; it is noninvasive ,is cheaper, radiation free, requires no anesthesia, is less operator dependent, allows better visualization of ducts proximal to an obstruction and when combined with conventional T1- and T2-weighted sequences allows detection of extraductal disease.

Though MRCP offers many advantages it still has few drawbacks like, low spatial resolution, making it less sensitive to abnormalities of the peripheral intrahepatic ducts (eg, sclerosing cholangitis) and pancreatic ductal side branches (e.g. chronic pancreatitis),imaging in the physiologic, non-distended state, which decreases the sensitivity to subtle ductal abnormalities, image artifacts can be seen as bright signals arising from stationary fluid within the adjacent duodenum, duodenal diverticulae and ascitic fluid.[33] Most important of the lot being lack of therapeutic option.

Currently, MRCP has poorer resolution than direct cholangiography and can miss small stones (<4 mm), small ampullary lesions, primary sclerosing cholangitis, and strictures of the ducts. MRCP also has difficulty in visualizing small stones in the pancreatic duct. Obstructing stones are generally easier to identify than non-obstructing stones (especially if smaller than the thickness of the acquired image slices). Small stones may not be distinguishable from sludge, mucin or even blood. Stones >4 mm are easily identified.[34]

In our study group of 50 patients (28 males and 22 females), age ranging from 15 to 56 years, we evaluated various causes of biliary ductal obstruction. Commonest of the findings were choledocholithiasis (56%), malignancy (12%) and stricture (28%). In our study choledocholithiasis was the commonest beingn and ampullary malignancy to be the most common malignant cause of biliary obstruction which is consistent with most of the studies carried out worldwide. Most authors have found biliary obstruction to be commoner in women[35] which was not the case in our study.

In our study the sensitivity of MRCP was found to be 87.5 % for choledocholithiasis, 100%for CBD malignancy, 84.6%for CBD stricture and 100%for biliary dilatation, which was comparable to the accuracy of MRCP, evaluated by various authors. Overall sensitivity of various studies lies within 74.6-90% for choledocholithiasis, 90-94% for CBD malignancy, 85-90% for strictures, and 90-96% for biliary dilatation.

In our study 3 patients had IHBR strictures on MRCP which were confirmed on ERCP. Thus MRCP showed 100% sensitivity and specificity in detecting IHBR strictures. According to C Bhatt et al[36] there was no much difference in sensitivity and specificity of MRCP in detecting intrahepatic biliary strictures. Strictures were seen as narrowing of biliary radicles with upstream dilatation, Fig (4). The location and extent of stricture correlated with ERCP in all cases.

About 28 of 50 patients had CBD stones. It was observed that MRCP has sensitivity and specificity of 87.5% and 100% respectively in detecting bile duct stones whereas sensitivity and specificity of ERCP was 100% considering ERCP is gold standard, which is consistent with the study conducted by Verma D et al which showed sensitivities of EUS and MRCP for the detection of choledocholithiasis to be 93% and 85%.[37] Stones on MRCP as well as ERCP are seen as filling defects in lumen of CBD with or without dilatation of CBD and IHBR (Figure 16).The location and number of stones found on MRCP was found to correlate with ERCP in all cases. About 14 patients had CBD strictures, which were seen as narrowing of CBD with upstream dilatation (Figure17).

It was observed in our study that the sensitivity of MRCP was 84% and specificity was 92% in detecting CBD strictures Figure 18). According to the study conducted by Nyree Griffin et al reported sensitivity of 91-100%.[38] So the sensitivity attained in our study was slightly lower than Nyree Griffin et al but comparable to other studies and fall within the overall sensitivity range of studies carried out worldwide.

In our study MRCP showed sensitivity and specificity 100 % for CBD tumors which was higher than the study conducted by Pamos S et al[39] where the sensitivity and specificity was 100 and 83.3% respectively. Additionally MRCP was found to be better in delineating the extent of tumor and extra biliary extension. As other sequences could simultaneously be acquired resectability and nodal status could also be assessed. ERCP images showed the level of block however the proximal extent and involvement of adjacent structures could not be evaluated.

Only four patients in our study had ampullary carcinoma with histopathologic confirmation (Figure 19) out of which the sensitivity and specificity of MRCP was around 50 % and 97.9 % for MRCP and 50% and 97.9% for ERCP. Of the four patients detected on ERCP and MRCP only two was confirmed by HPE. In one patient in whom MRCP and HPE suggested ampullary carcinoma, ERCP detected no ampullary carncioma thus favoring MRCP.

According to the study conducted by Chen WX et al[40] sensitivity and specificity in detection of ampullary carcinoma was 100% for ERCP and 26.83% for MRCP, while in our study it was 50 % and 97.9% for both. They found significant difference between MRCP and ERCP accuracy rate hence recommended ERCP in detecting ampullary carcinoma whereas our study which is in more in favor of MRCP. However owing to small sample result is inconclusive. MRCP however should score over ERCP as it offers additional advantage of simultaneous cross-sectional imaging.

About 60% patients were detected to have biliary radical dilatation on MRCP as well as ERCP. Thus MRCP had 100% sensitivity and specificity in detecting biliary duct dilatation compared to ERCP. According to Angulo et al diagnostic accuracy of MRCP was found to be greater than 90% in diagnosing biliary duct dilatation[14] which is slightly lesser than the results of our study.

Out of 50 patients 6% had gall bladder stones in whom MRCP sensitivity and specificity was 100% and 97.9%. According to Calvo MM[41] the sensitivity of MRCP in detecting cholelithiaisis was 97.7% which is comparable with the results of our study. On MRCP stones were seen as filling defects in gall bladder.

Pancreatic dilatation was detected in two patients, the sensitivity and specificity of MRCP in diagnosing pancreatic duct dilatation in our study was

100% and 97.9%. According to Meng Z the sensitivity of MRCP in detecting pancreatic duct dilatation was 72.7%.[42]

There were 2 patients who were detected to have ampullary stones and its sensitivity, specificity was 100% and 97.9% compared to ERCP. No major studies evaluating ampullary stones could be found, mostly as all cases of ampullary stones may be included in choledocholithiasis. However, no significant conclusion can be derived as the sample size is small.

Ampullary stricture was found in two patients, sensitivity and specificity was 0% and 97.9%. The false positive rates of MRCP were high; hence ERCP should be considered modality of choice for ampullary stricture.

One out of 50 patients was diagnosed to have pancreatic divisum in MRCP which was not detected in ERCP therefore MRCP was to found to be false positive. According to Mosler et al ERCP is considered as gold standard method in pancreas divisum diagnosis. According to their study sensitivity of MRCP in diagnosing pancreas divisum was around 73.3%.[30] Thus results in our study were in conclusive as study sample size was small.

Thus to conclude, MRCP has high sensitivity for CBD and intra-hepatic biliary radical abnormalities such as stones, strictures and malignancies. MRCP may have slightly lower sensitivity for stone detection, but still to avoid unnecessary diagnostic ERCP; in cases with suspicion (clinical/CBD -IHBR dilatation on USG) of choledocholithiasis/ampullary stones, MRCP is recommended.

MRCP has comparable sensitivity for malignancies and offers additional advantage of cross-sectional imaging, hence should score over ERCP. Sensitivity of MRCP for anicillary findings like gall stones and intraheaptic biliary radical dilatation is comparable to ERCP. While for lower biliary system abnormalities like ampullary stricture and pancreatic duct abnormalities; ERCP may be preferred. For ampullary stones though, MRCP shows equivalent sensitivity but marginally low specificity as compared to ERCP. In one of the cases of ampullary carcinoma MRCP was positive while ERCP was not, which is likely to be an isolated case, considering the fact that other studies have shown considerably high sensititvity of ERCP compared to MRCP, for ampullary tumor detection. However the sample size is a limiting factor for any definitive conclusion.

SUMMARY

SUMMARY

This was our prospective study of 50 patients the various common causes of obstructive jaundice were assessed with MRCP and the diagnostic efficacy of MRCP was evaluated comparing with ERCP and histopathology if available.

Of the 50 patients 6% had IHBR strictures, 56% had CBD stones, 28% had CBD strictures, 12% had CBD tumors, 4% had ampullary stones, 4% had ampullary strictures and 8% had ampullary tumor.

In our study 3 patients had IHBR strictures where MRCP showed 100% sensitivity and specificity in detecting IHBR strictures. Of the 50 patients 28 had CBD stones, it is observed that MRCP has sensitivity and specificity of 87.5% and 100% respectively in detecting Bile duct stones, whereas sensitivity and specificity of ERCP was 100% each.

In our study 6 had CBD tumors out of 50 patients in which the sensitivity and specificity ranges between 100 % and 92.3%. Only four patients in our study had ampullary carcinoma out of which the sensitivity and specificity came around 66.6% and 100 % for MRCP and 33.3% and 97.9% for ERCP. One patient, in whom MRCP and HPE detected ampullary carcinoma, ERCP detected no ampullary carncioma thus favoring MRCP.

However owing to inadequate study population results are inconclusive. There is significant difference between MRCP and ERCP accuracy rate in detection of ampullary carcinoma. Therefore their study recommends ERCP in detecting ampullary carcinoma whereas our study which is more in favor of MRCP.

There were 60% patients who were detected with biliary duct dilatation in ERCP which was equally detected in MRCP. Thus MRCP had 100% sensitivity and specificity in detecting biliary duct dilatation compared to ERCP.

Out of 50 patients 6% had gall bladder stones in whom MRCP sensitivity and specificity detecting gall bladder stones came up to 100% and 97.9% and was found to comparable with ERCP.

One patient out of 50 patients was diagnosed to have pancreatic divisum in MRCP which was not detected in ERCP therefore MRCP was to found to be false positive. Pancreatic dilatation was detected in two patients and there were 2 patients who were detected with ampullary stones and its sensitivity, specificity came up to 100% and 97.9% compared to ERCP. Another two patients who were found to have ampullary strictures whose sensitivity and specificity in MRCP was calculated and came up to 0% and 97.9%. Owing to inadequate study population in above mentioned pathologies the results were inconclusive.

CONCLUSION

CONCLUSION

The aim of our study was to evaluate the diagnostic efficacy of MRCP compared to ERCP as a diagnostic our institution, using specificity, sensitivity, and positive and negative predictive values.

- We conclude that MRCP has high diagnostic accuracy and is equivalent to ERCP in diagnosing (IHBR and CBD) abnormalities like IHBR strictures and CBD tumors.

- In cases of CBD strictures, CBD stones and ampullary stones, MRCP is comparable to ERCP.

- For ampullary tumors sensitivity of MRCP and ERCP was equivalent, which may be fallacious considering the small sample size.

- For lower biliary tract abnormalitites like ampullary stricture and pancreatic ductal abnormalitites MRCP was found to have lower sensitivity.

- Ancillary findings like intrahepatic biliary radical dilatation and gall stone disease are well demonstrated on MRCP.

- MRCP as the method of choice for the diagnostic imaging of biliary and ERCP is reserved for therapeutic intervention in this setting as the commoner pathologies (stones ,strictures and malignancies in upper biliary tract) can be easily identified with high specificity with MRCP.

- In cases wherein histopathology were available, that is in cases of tumors, MRCP showed high specificity as well as sensitivity.

- The results obtained in the study were comparable to pioneer studies conducted worldwide. However major limitation was small sample size.

LIMITATIONS AND RECOMMENDATIONS

LIMITATIONS

- Small study population, owing to difficulty in collecting patients who underwent both ERCP and MRCP, as most of the patients after ultrasound are directly subjected to ERCP.

RECOMMENDATIONS

- We would propose that all cases of obstructive jaundice should undergo MRCP so that ERCP can be used only for therapeutic purpose.

- MRCP should be performed in cases of CBD / pancreatic duct dilatation (when the clinical data and USG abdomen are inconclusive) to RULE OUT presence of stones, strictures and malignancies to avoid complications of diagnostic ERCP.

- MRCP should be performed in cases of suspected malignancies in hilar region, CBD and ampulla as it provides ancillary information as discussed.

- MRCP is first hand tool for diagnosing biliary abnormalities.

IMAGES

IMAGES

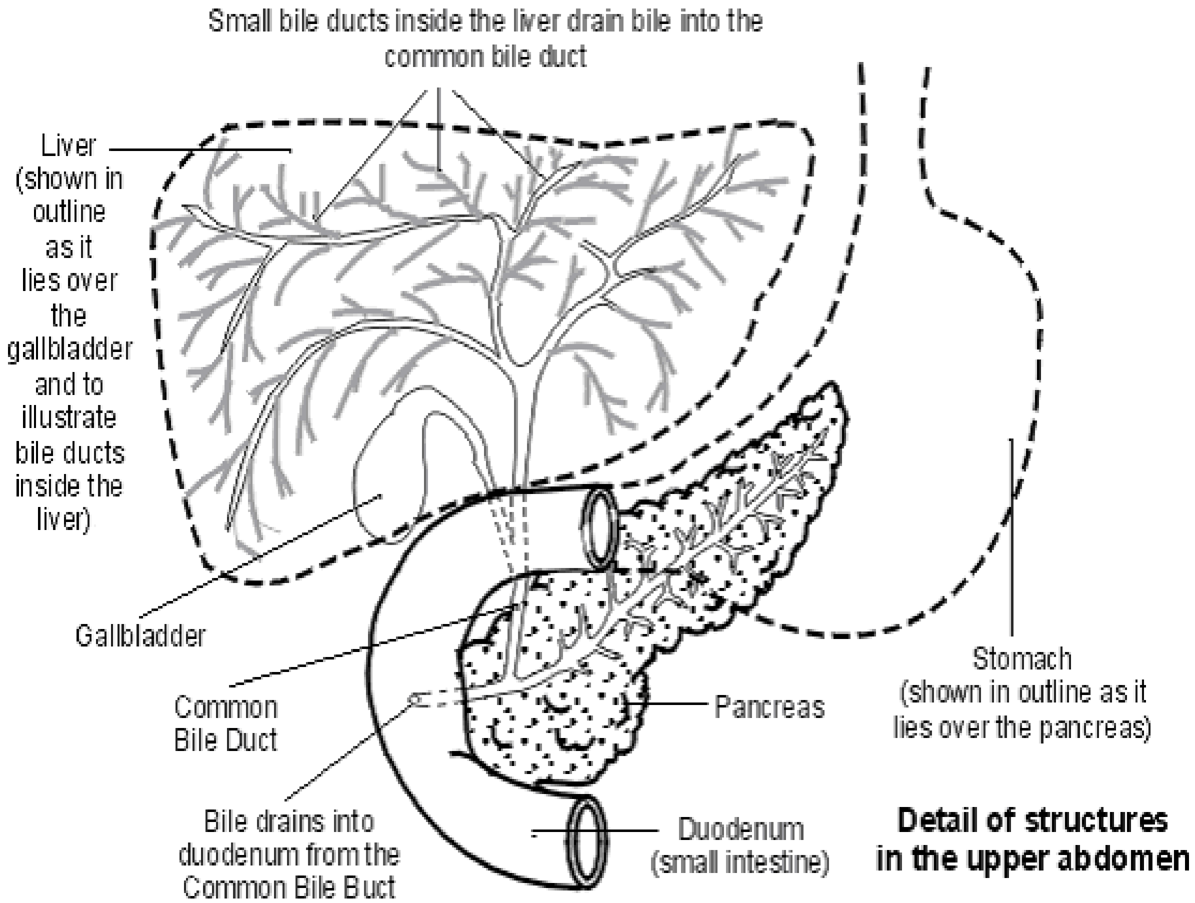


FIG.13 PANCREATICO-BILIARY SYSTEM

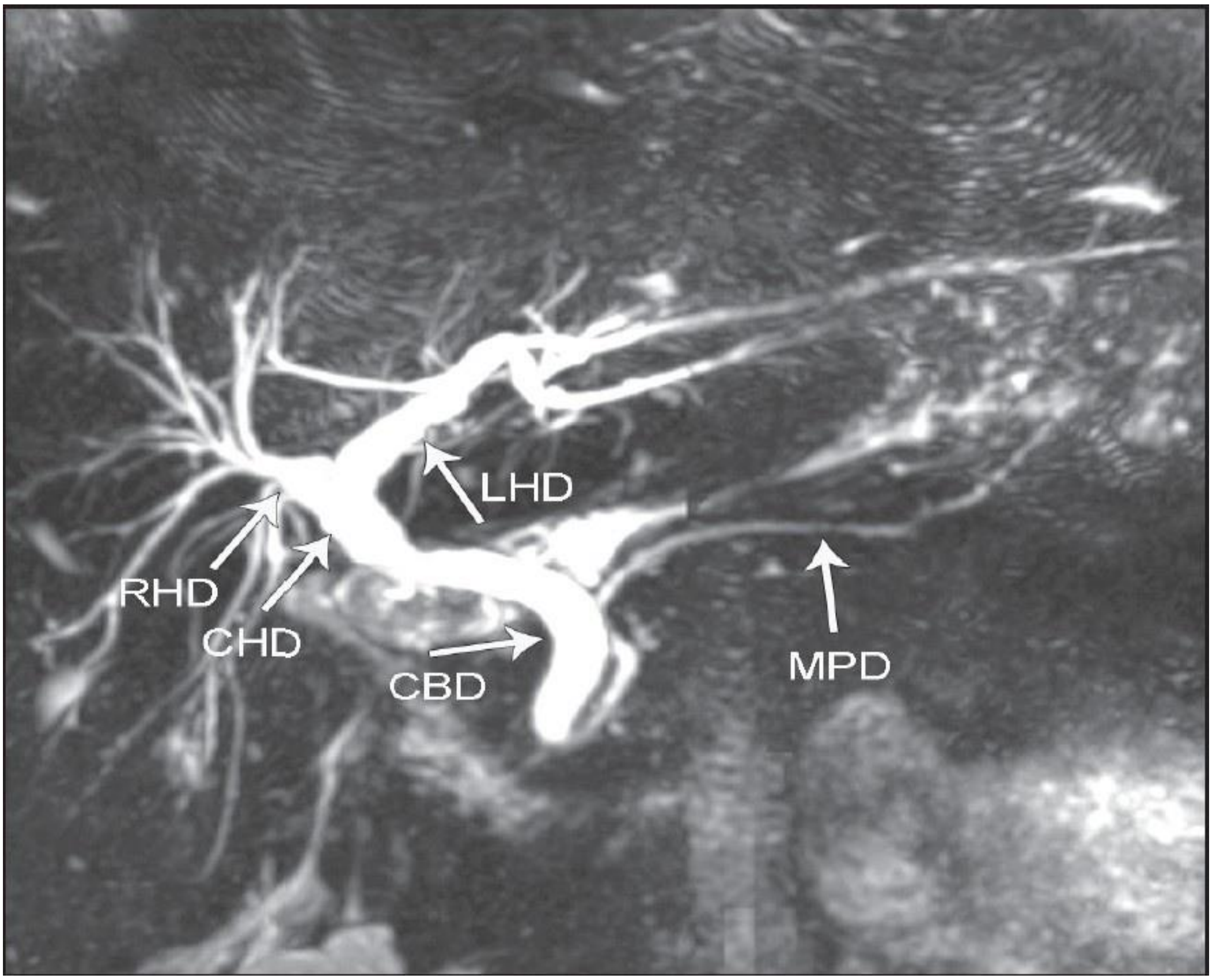


Fig.14 The MRCP anatomy of biliary tree is as shown in the image

Fig .15 ERCP

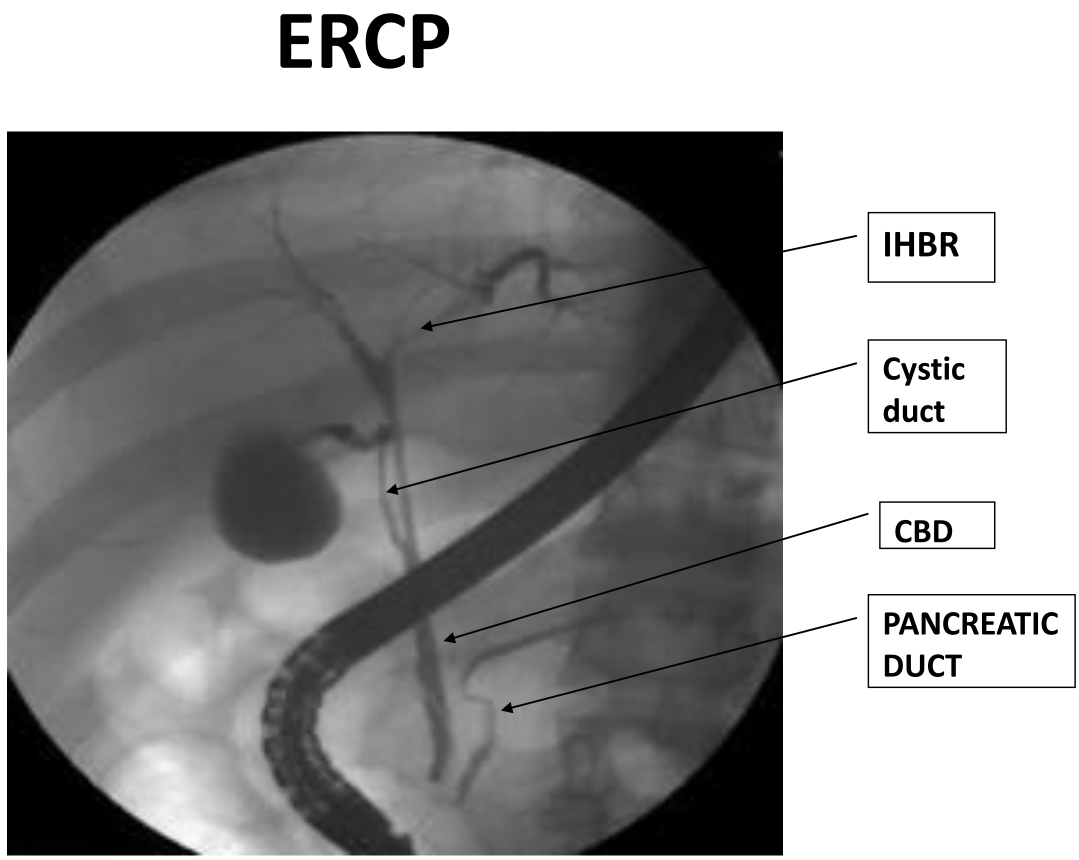


Figure: 15 ERCP

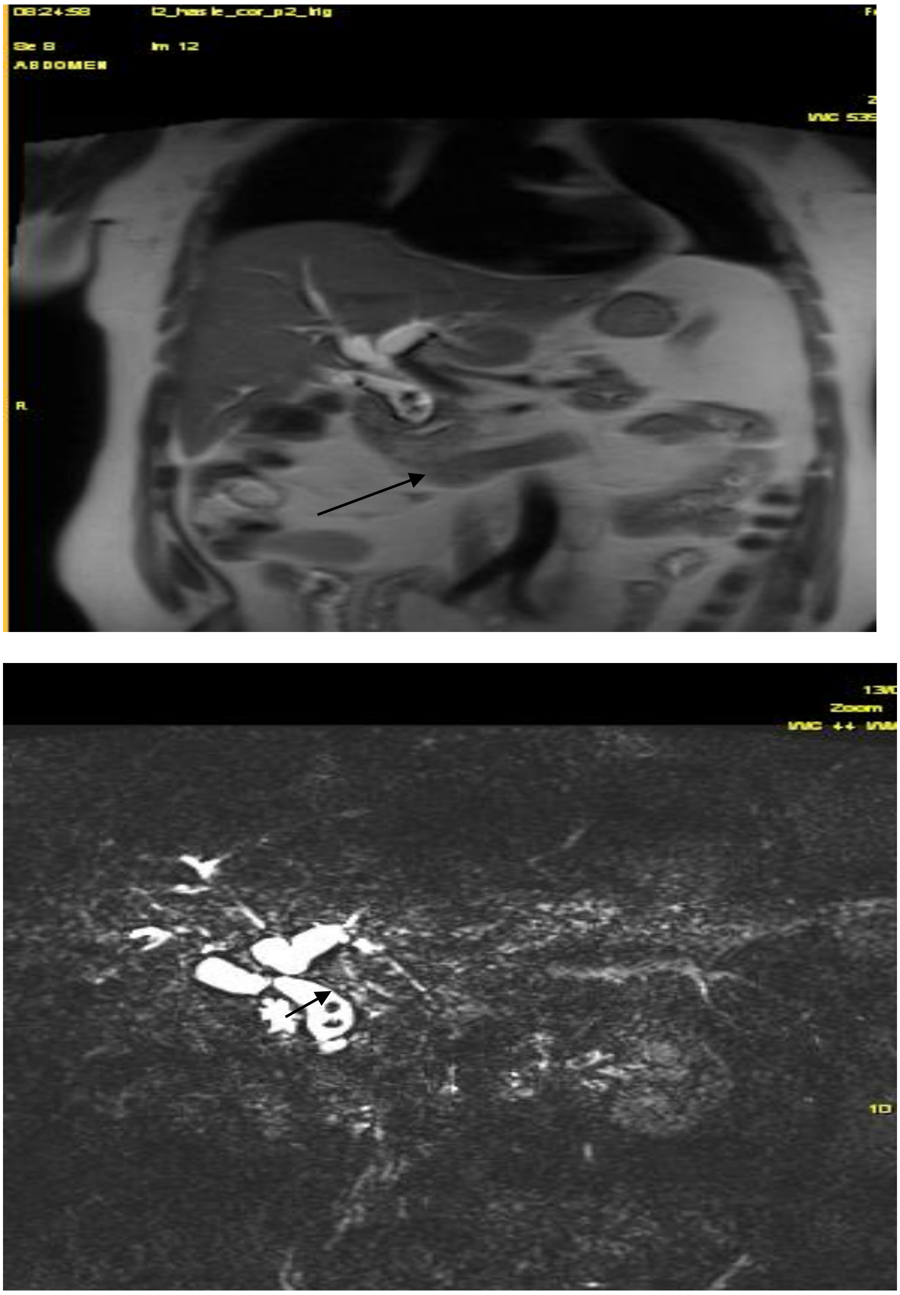


Figure: 16 CBD stones is seen as filling defects in ERCP and MRCP

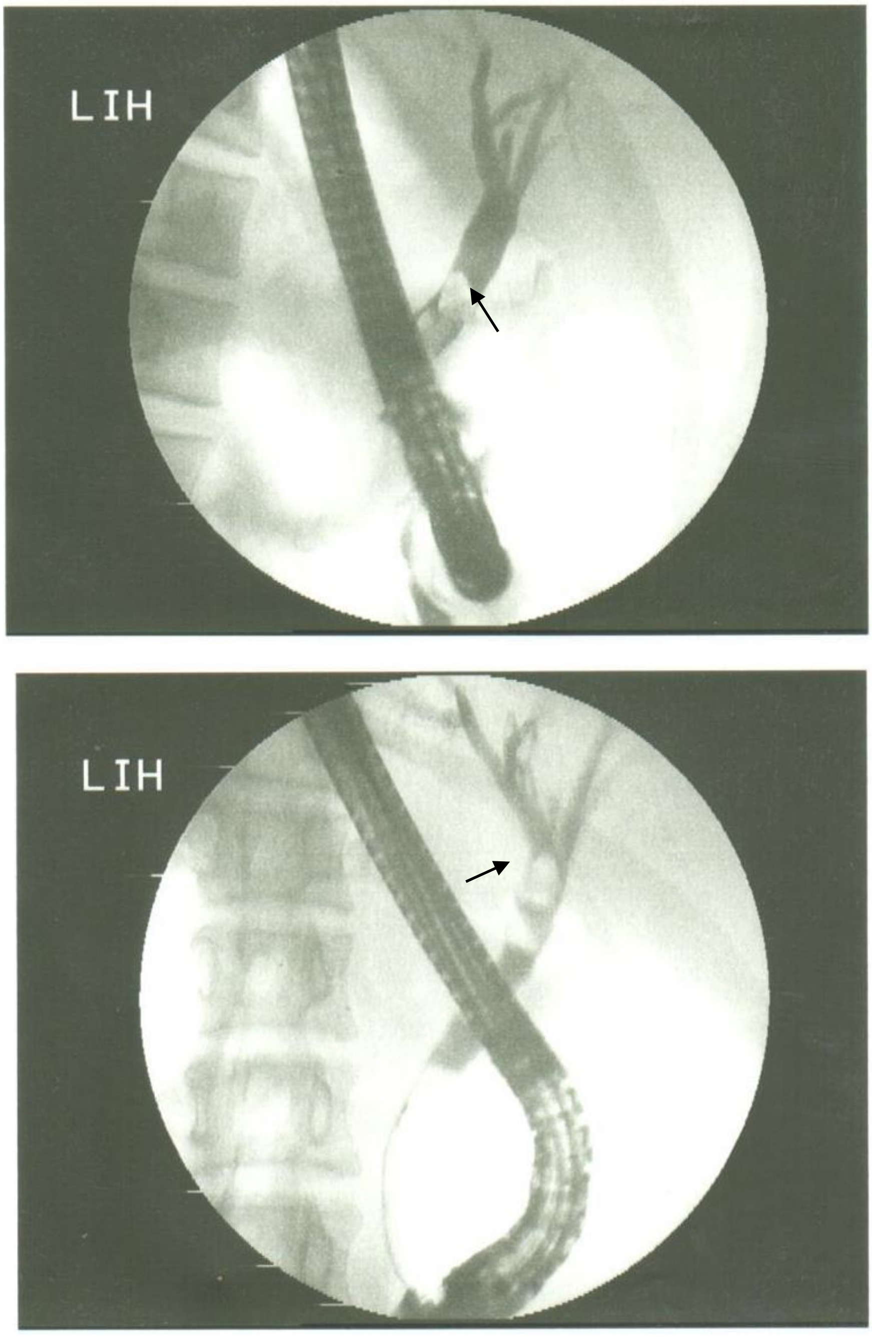


Figure: 17. CBD stones is seen as filling defects in ERCP and MRCP

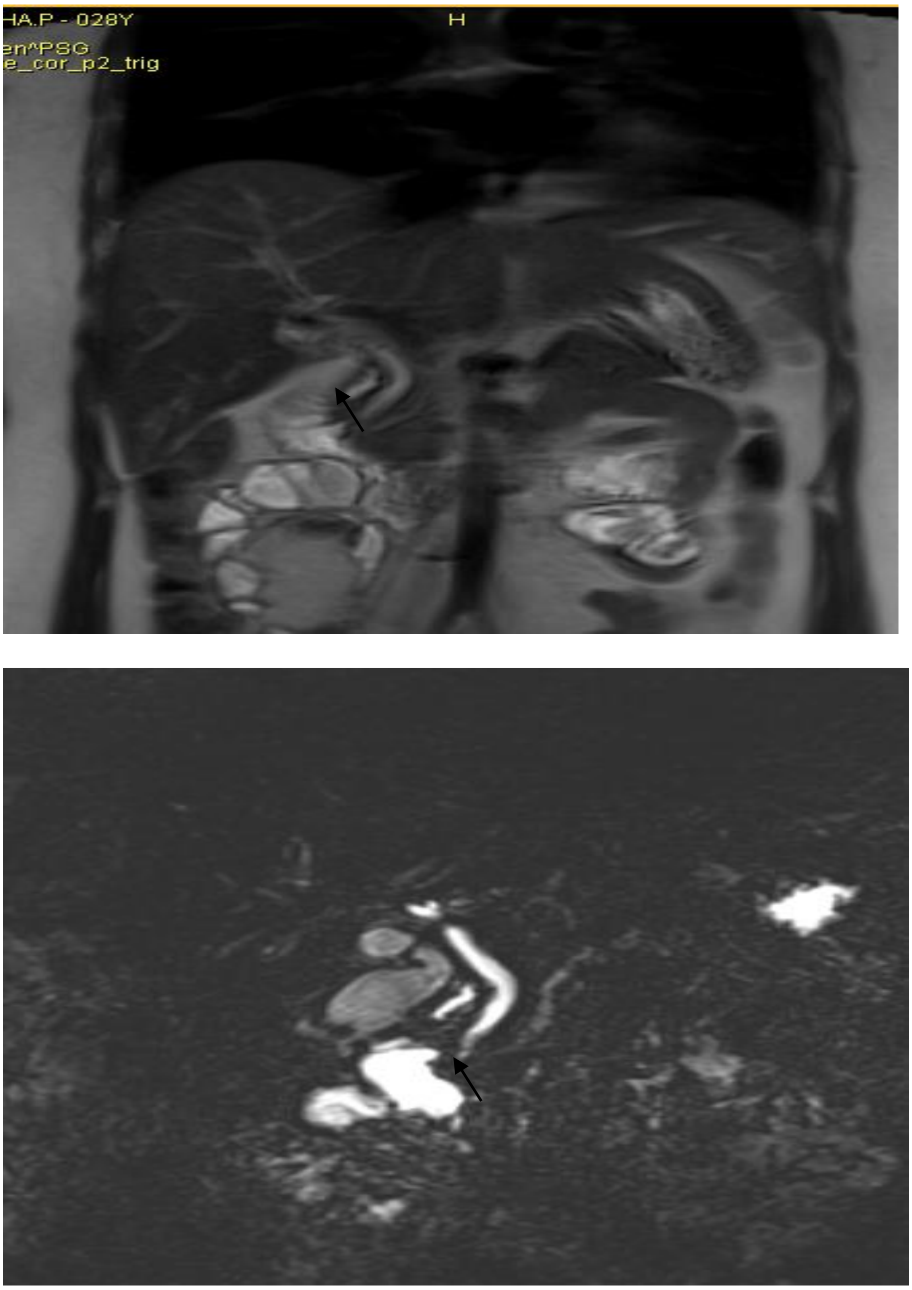


Figure: 18. CBD strictures seen as narrowing of the duct in ERCP and MRCP

Figure: 19. Thick slab image showing CBD stricture

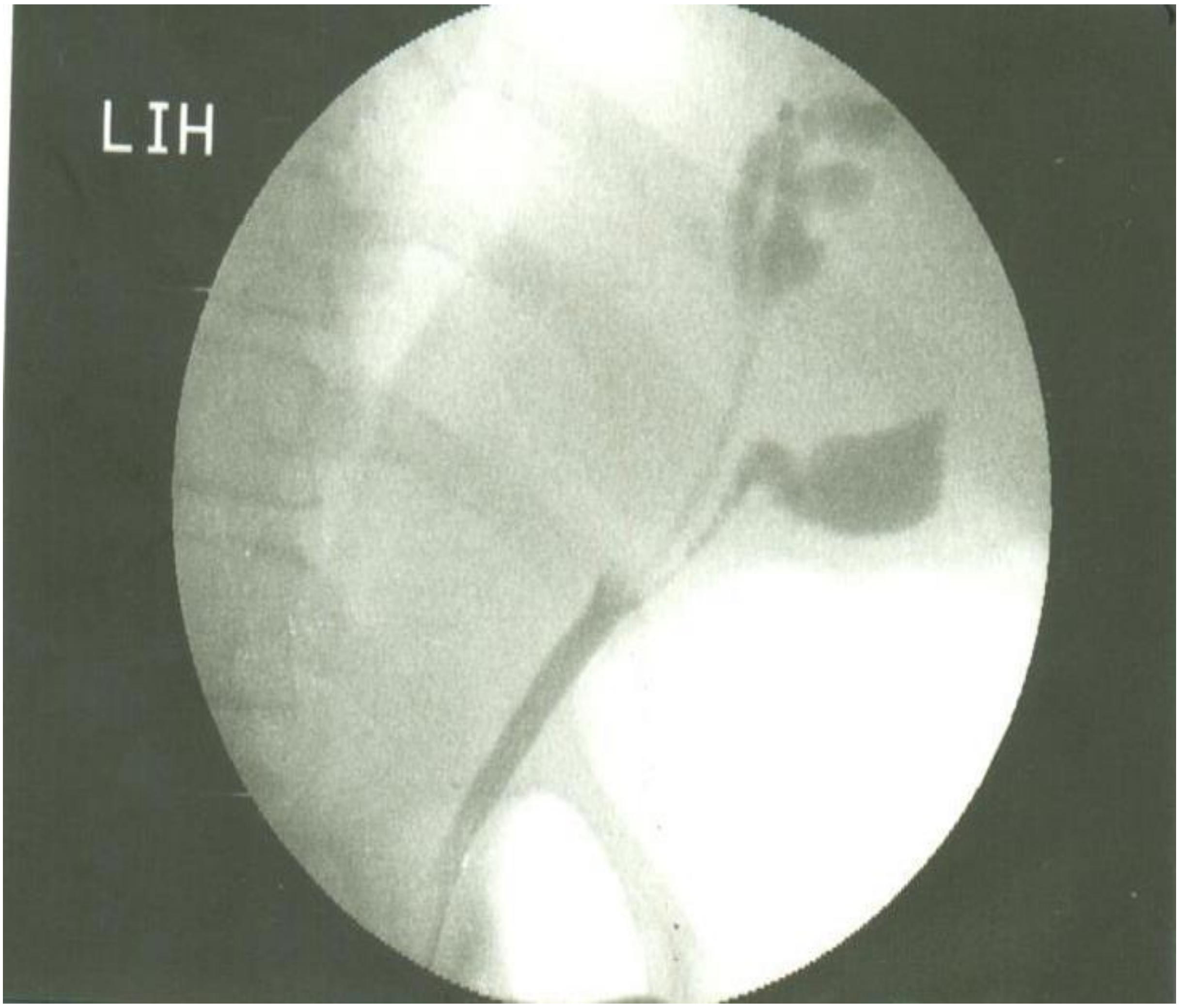


Figure: 20. CBD strictures seen as narrowing of the duct in ERCP and MRCP

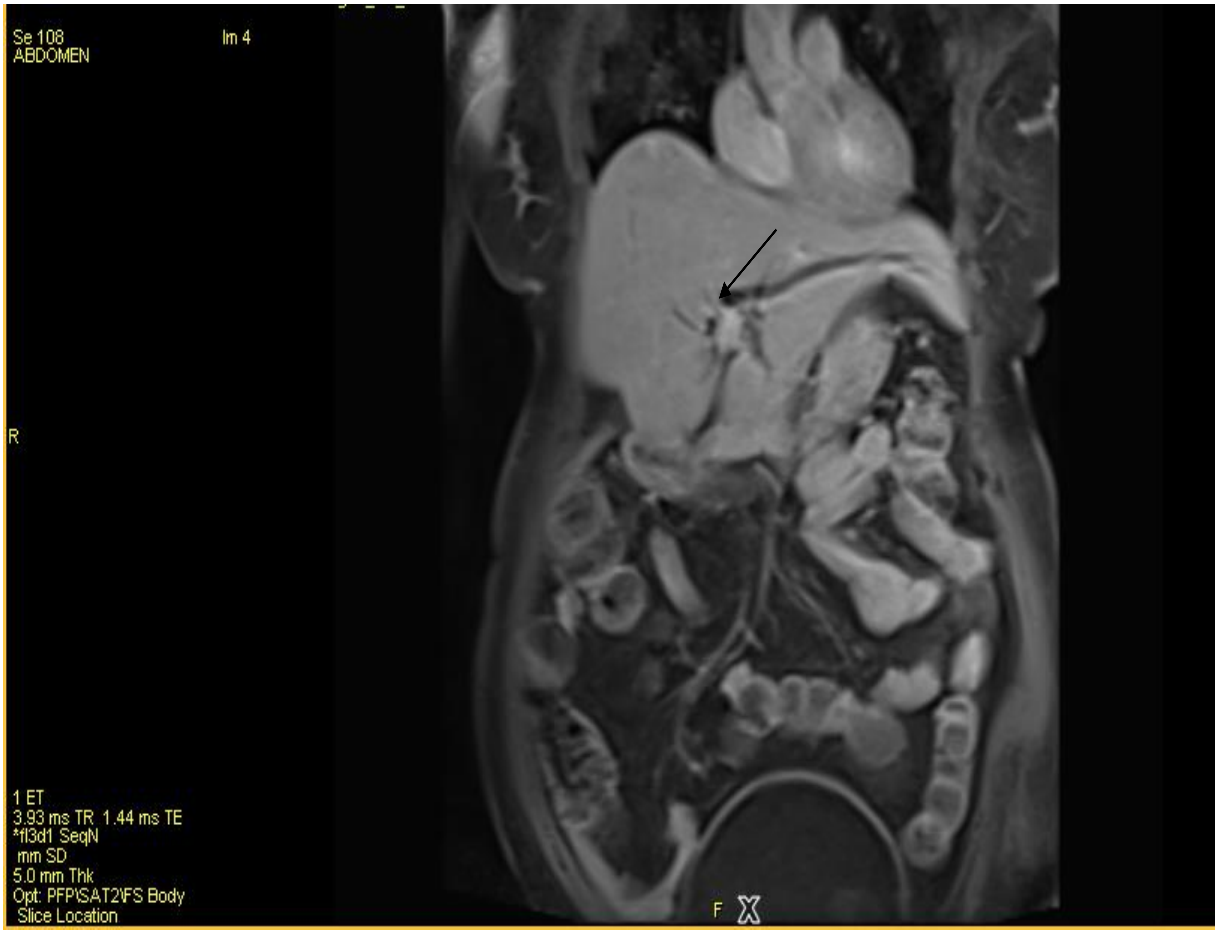


Figure: 21. CBD tumor: Moderate dilatation of the intrahepatic biliary channels. There is abrupt cut of off the biliary channels at the site of the confluence of the common hepatic duct. The confluence of the right anterior spectral duct could not be visualized. Post contrast shows mild poorly defined enhancement of the confluence.

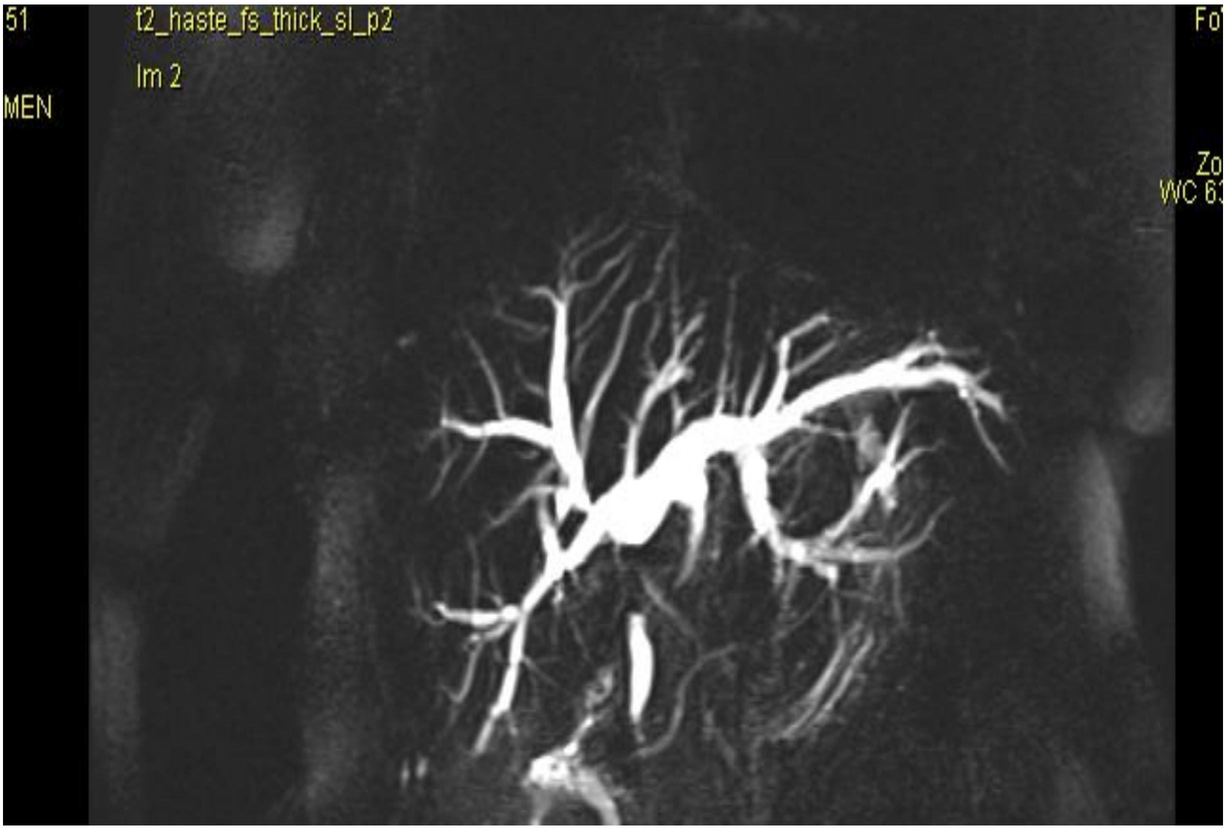


Figure: 22. Thick slab image showing: Moderate dilatation of the intrahepatic biliary channels. There is abrupt cut of off the biliary channels at the site of the formation of the common hepatic duct.

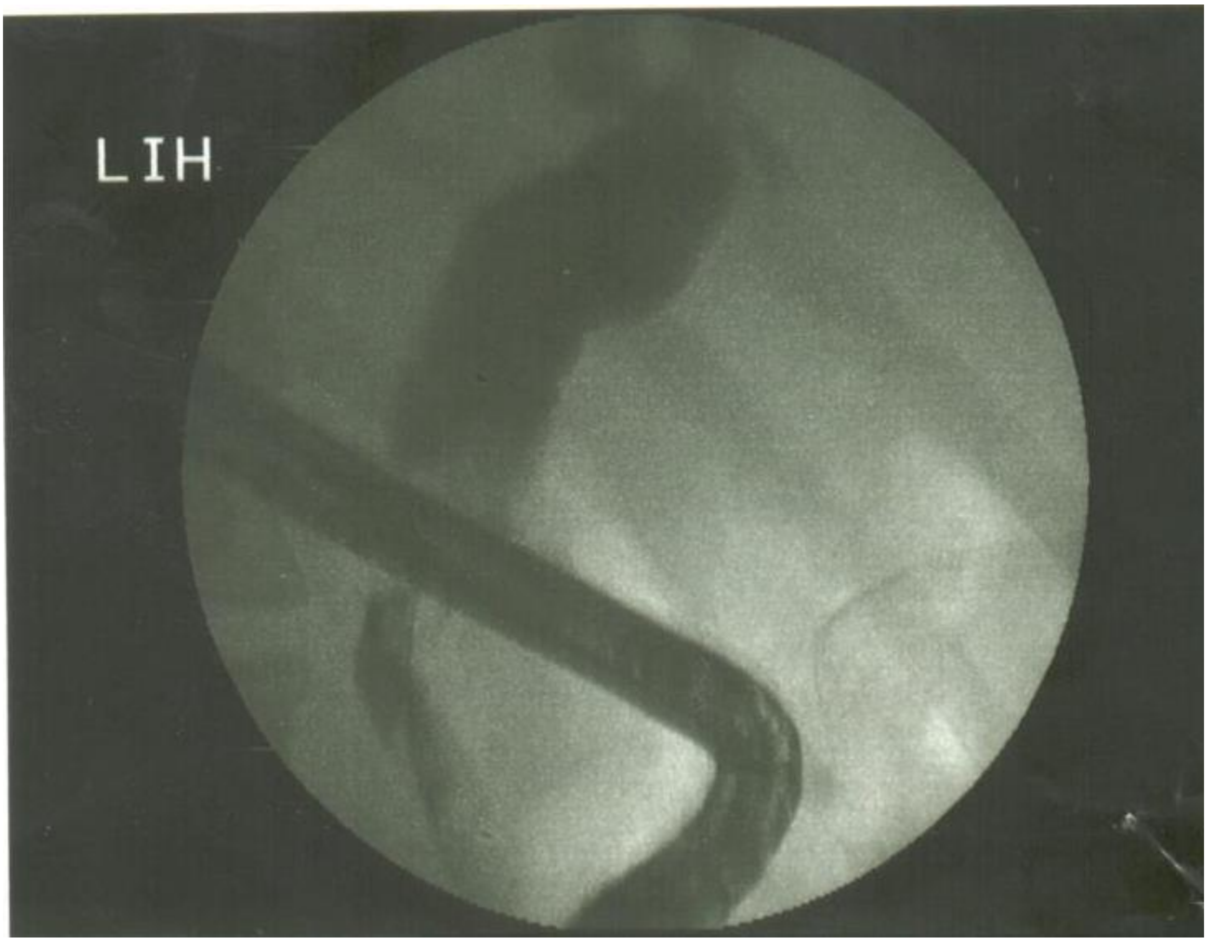


Figure: 23. ERCP showing features of CBD tumor

Figure: 24. Mass lesion in the region of ampulla with upstream dilatation of CBD

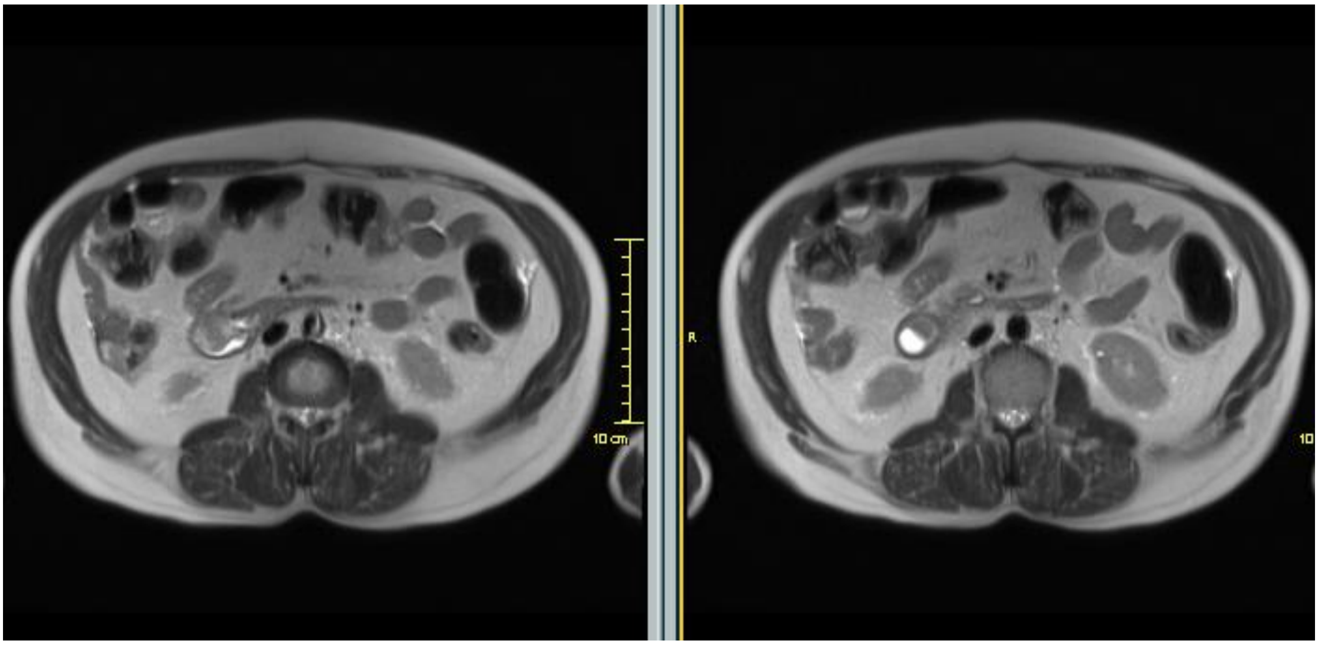


Figure:22 Mass lesion in the region of ampulla with upstream dilatation of CBD in the region of ampulla with upstream dilatation of CBD

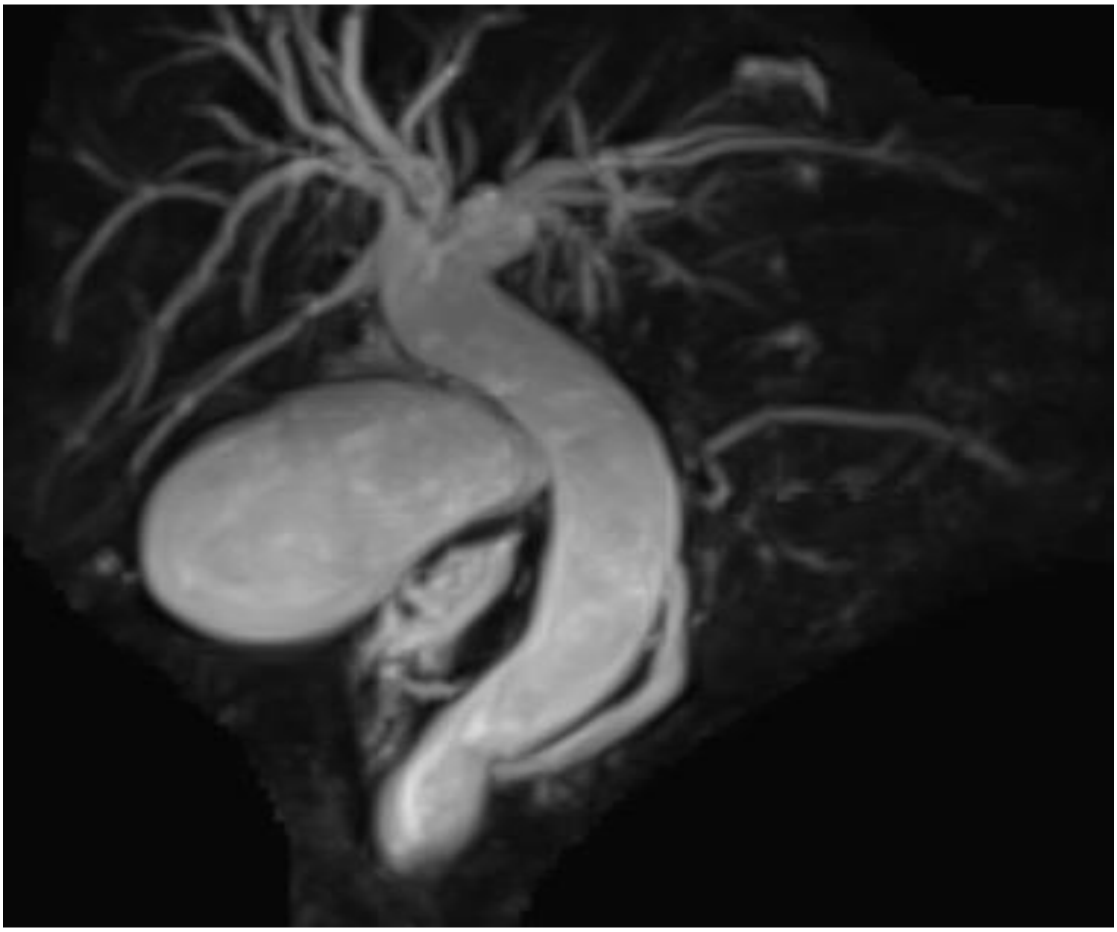


Figure 22 Thick slab image showing upstream dilatation of CBD and dilatation of pancreatic duct in ampullary carcinoma

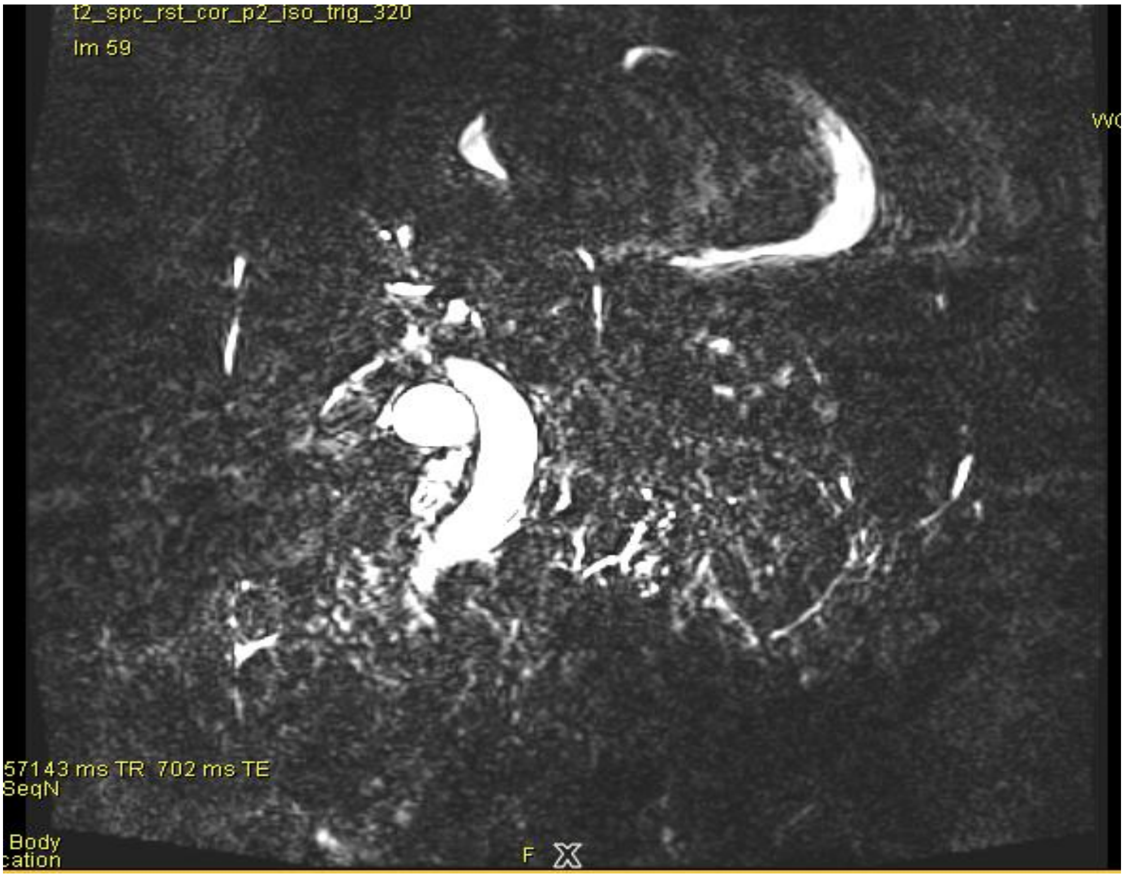


Figure: 25. Space sequence showing ampullary mass lesion causing upstream dilatation of CBD.

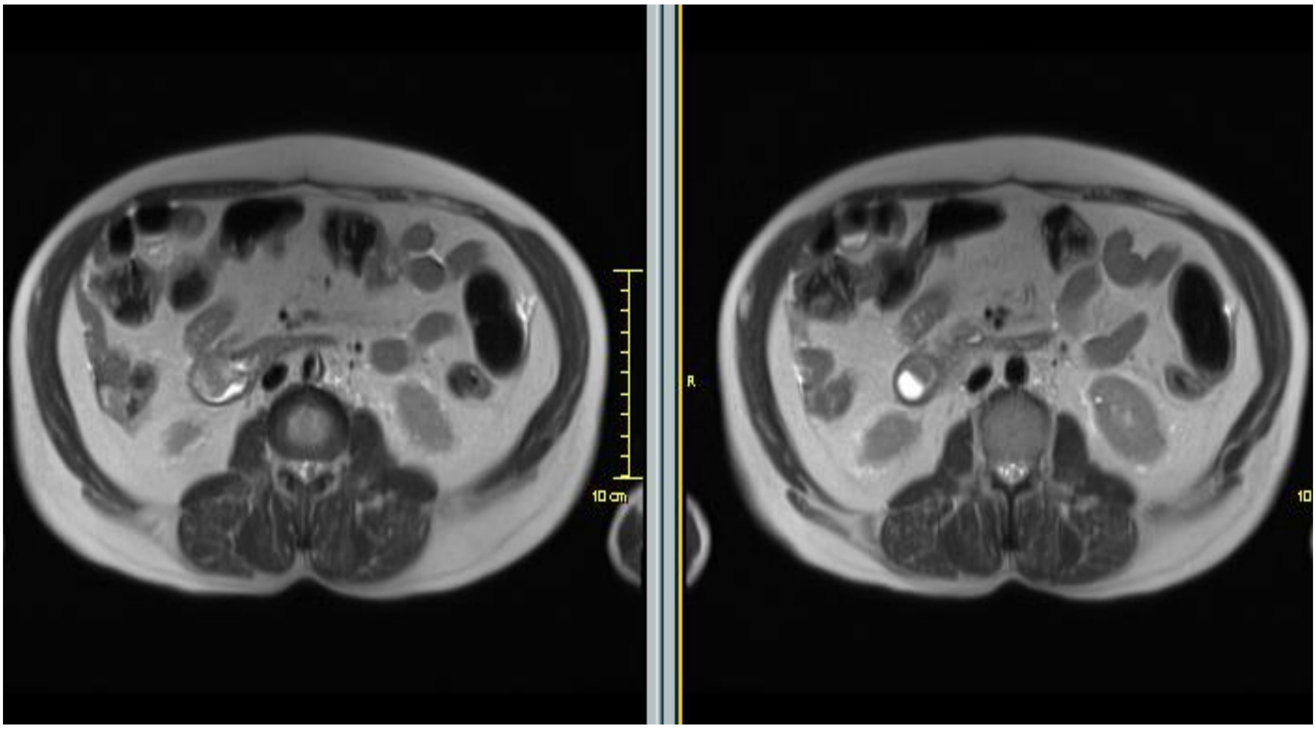


Figure: 26. Mass lesion in the region of ampulla with upstream dilatation of CBD.

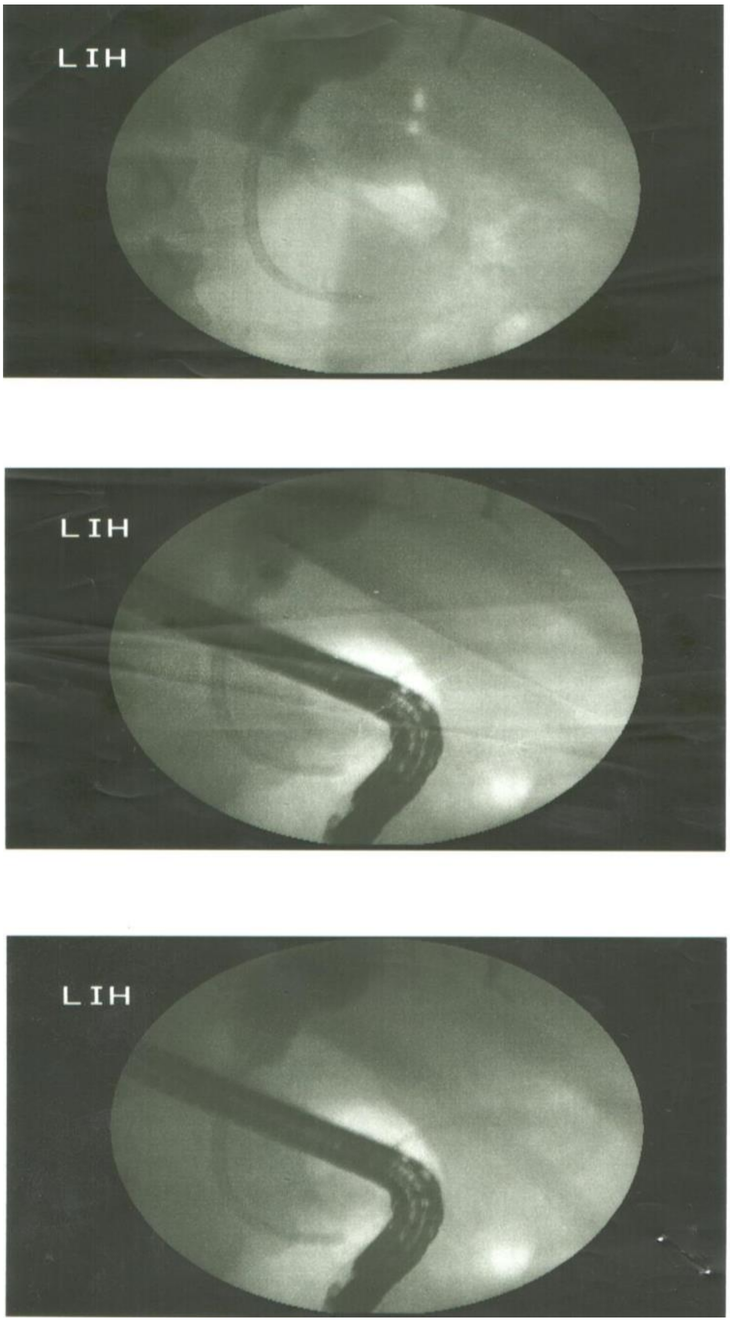


Figure: 27. Shows features of ampullary tumor in ERCP with upstream dilatation of CBD

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Tse F, Barkun JS, Romagnuolo J, Friedman G, Bornstein JD, Barkun AN. Nonoperative imaging techniques in suspected biliary tract obstruction. HPB (Oxford). 2006;8(6):409-25.

2. Hurter D, De Vries C, Potgieter P, Barry R, Botha F, Joubert G. Accuracy of MRCP compared to ERCP in the diagnosis of bile duct disorders. South African Journal of Radiology. 2008;12(1):14-22.

3. Bashir O. Biliary tree anatomy [Internet]. 2014 [cited 2014 Sep 20]. Available from: http://radiopaedia.org/articles/biliary-tree-anatomy.

4. Gray H, Standring S, Ellis H, Berkovitz B. Gray's anatomy. 1st ed. Edinburgh: Elsevier Churchill Livingstone; 2008.

5. Brant W, Helms C. Fundamentals of diagnostic radiology. 1st ed. Philadelphia: Lippincott, Williams & Wilkins; 2007.

6. Maccioni F, Martinelli M, Al Ansari N, Kagarmanova A, De Marco V, Zippi M, Marini M. Magnetic resonance cholangiography: past, present and future: a review. Eur Rev Med Pharmacol Sci. 2010 Aug;14(8):721-5.

7. Coakley FV, Schwartz LH. Magnetic resonance cholangiopancreatography. J Magn Reson Imaging. 1999 Feb;9(2):157-62.

8. Tripathi RP, Batra A, Kaushik S. Magnetic resonance cholangiopancreatography: evaluation in 150 patients. Indian J Gastroenterol. 2002 May-Jun;21(3):105-9.

9. Christodoulou DK, Tsianos EV. Role of endoscopic retrograde cholangiopancreatography in pancreatic diseases. World J Gastroenterol. 2010 Oct 14;16(38):4755-61.

10. Huang LY, Liu YX, Wu CR, Cui J, Zhang B. Application of endoscopic retrograde cholangiopancreatography in biliary-pancreatic diseases. Chin Med J (Engl). 2009 Dec 20;122(24):2967-72.

11. Ueno E, Takada Y, Yoshida I, Toda J, Sugiura T, Toki F. Pancreatic diseases: evaluation with MR cholangiopancreatography.Pancreas. 1998 Apr;16(3):418-26.

12. Vitellas KM, Keogan MT, Spritzer CE, Nelson RC. MR cholangiopancreatography of bile and pancreatic duct abnormalities with emphasis on the single-shot fast spin-echo technique. Radiographics. 2000 Jul-Aug;20(4):939-57; quiz 1107-8, 1112. Review. Erratum in: Radiographics 2000 Sep-Oct;20(5):1494.

13. Albert JG, Riemann JF. ERCP and MRCP--when and why. Best Pract Res Clin Gastroenterol. 2002 Jun;16(3):399-419.

14. Angulo P, Pearce DH, Johnson CD, Henry JJ, LaRusso NF, Petersen BT, Lindor KD. Magnetic resonance cholangiography in patients with biliary disease: its role in primary sclerosing cholangitis. J Hepatol. 2000 Oct;33(4):520-7.

15. Rahman R, Ju J, Shamma's J, Goebel S, Sundaram U. Correlation between MRCP and ERCP findings at a tertiary care hospital. W V Med J. 2010 Jul-Aug;106(5):14-9.

16. Liang C, Mao H, Wang Q, Han D, Li Yuxia L, Yue J, Cui H, Sun F, Yang R. Diagnostic performance of magnetic resonance cholangiopancreatography in malignant obstructive jaundice. Cell Biochem Biophys. 2011 Nov;61(2):383-8.

17. Miletić D, Stimac D, Uravić M, Petranović D, Mazur-Grbac M, Valković P, Franko A. [Magnetic resonance cholangiopancreatography]. Lijec Vjesn. 2007 Oct-Nov;129(10-11):336-43.

18. Soto JA, Barish MA, Yucel EK, Siegenberg D, Ferrucci JT, Chuttani R. Magnetic resonance cholangiography: comparison with endoscopic retrograde cholangiopancreatography. Gastroenterology. 1996 Feb;110(2):589-97.

19. Kaltenthaler EC, Walters SJ, Chilcott J, Blakeborough A, Vergel YB, Thomas S. MRCP compared to diagnostic ERCP for diagnosis when biliary obstruction is suspected: a systematic review. BMC Med Imaging. 2006 Aug 14;6:9.

20. Vaníček J, Kyselová H, Kianička B, Mikulicová R, Bajgarová B, Trna J, Souček M, Riháček I, Spác J. [Comparison of MRCP a ERCP in diagnosis of choledocholithiasis]. Vnitr Lek. 2013 May;59(5):357-60.

21. Norero E, Norero B, Huete A, Pimentel F, Cruz F, Ibáñez L, Martínez J, Jarufe N. [Accuracy of magnetic resonance cholangiopancreatography for the diagnosis of common bile duct stones]. Rev Med Chil. 2008 May;136(5):600-5.

22. Miao L, Fan ZN, Ji GZ, Wen W, Wang X, Xiong GY, Jiang GB, Wang M, Liu Z, Wu P. [Comparative study of ultrasonography, magnetic resonance cholangiopancreatography and endoscopic retrograde cholangiopancreatography in common duct stones]. Zhonghua Wai Ke Za Zhi. 2008 Oct 1;46(19):1465-7.

23. Hekimoglu K, Ustundag Y, Dusak A, Erdem Z, Karademir B, Aydemir S, Gundogdu S. MRCP vs. ERCP in the evaluation of biliary pathologies: review of current literature. J Dig Dis. 2008 Aug;9(3):162-9.

24. Halefoglu AM. Magnetic resonance cholangiopancreatography: a useful tool in the evaluation of pancreatic and biliary disorders.World J Gastroenterol. 2007 May 14;13(18):2529-34.

25. Howard K, Lord SJ, Speer A, Gibson RN, Padbury R, Kearney B. Value of magnetic resonance cholangiopancreatography in the diagnosis of biliary abnormalities in postcholecystectomy patients: a probabilistic cost-effectiveness analysis of diagnostic strategies. Int J Technol Assess Health Care. 2006 Winter;22(1):109-18.

26. Adamek HE, Albert J, Weitz M, Breer H, Schilling D, Riemann JF. A prospective evaluation of magnetic resonance cholangiopancreatography in patients with suspected bile duct obstruction. Gut. 1998 Nov;43(5):680-3.

27. Adamek HE, Albert J, Breer H, Weitz M, Schilling D, Riemann JF. Pancreatic cancer detection with magnetic resonance cholangiopancreatography and endoscopic retrograde cholangiopancreatography: a prospective controlled study. Lancet. 2000 Jul 15;356(9225):190-3.

28. Hintze RE, Adler A, Veltzke W, Abou-Rebyeh H, Hammerstingl R, Vogl T, Felix R. Clinical significance of magnetic resonance cholangiopancreatography (MRCP) compared to endoscopic retrograde cholangiopancreatography (ERCP). Endoscopy. 1997 Mar;29(3):182-7.

29. Siddique K, Ali Q, Mirza S, Jamil A, Ehsan A, Latif S, Malik AZ. Evaluation of the aetiological spectrum of obstructive jaundice. J Ayub Med Coll Abbottabad. 2008 Oct-Dec;20(4):62-6.

30. Mosler P, Akisik F, Sandrasegaran K, Fogel E, Watkins J, Alazmi W, Sherman S, Lehman G, Imperiale T, McHenry L. Accuracy of magnetic resonance cholangiopancreatography in the diagnosis of pancreas divisum. Dig Dis Sci. 2012 Jan;57(1):170-4.

31. Pasanen PA, Partanen KP, Pikkarainen PH, Alhava EM, Janatuinen EK, Pirinen AE. A comparison of ultrasound, computed tomography and endoscopic retrograde cholangiopancreatography in the differential diagnosis of benign and malignant jaundice and cholestasis. Eur J Surg. 1993 Jan;159(1):23-9.

32. Varghese JC, Farrell MA, Courtney G, Osborne H, Murray FE, Lee MJ. A prospective comparison of magnetic resonance cholangiopancreatography with endoscopic retrograde cholangiopancreatography in the evaluation of patients with suspected biliary tract disease. Clin Radiol. 1999 Aug;54(8):513-20.

33. Al-Dhuhli H. Role of magnetic resonance cholangiopancreatography in the evaluation of biliary disease. Sultan Qaboos Univ Med J. 2009 Dec;9(3):341-52.

34. Carroll JK, Herrick B, Gipson T, Lee SP. Acute pancreatitis: diagnosis, prognosis, and treatment. Am Fam Physician. 2007 May 15;75(10):1513-20.

35. 2. Khalid R. Bile Duct Obstruction: Causes, Treatment, & Prevention [Internet]. Healthline.com. 2014 [cited 24 September 2014]. Available from: http://www.healthline.com/health/bile-duct-obstruction#Overview1

36. Bhatt C, Shah P S, Prajapati H J, Modi J. Comparison of diagnostic accuracy between USG and MRCP in biliary and pancreatic pathology. Indian J Radiol Imaging. 2005;15:177-81.

37. Verma D, Kapadia A, Eisen GM, et al. EUS vs. MRCP for detection of choledocholithiasis. Systematic review. Gastrointest Endosc. 2006;64:248-254.

38. Griffin N, Charles-Edwards G, Grant LA. Magnetic resonance cholangiopancreatography: the ABC of MRCP. Insights Imaging. 2012 Feb;3(1):11-21.

39. Pamos S, Rivera P, Canelles P, Quiles F, Ortí E, Cuquerella J, Martínez V, Medina E. [Magnetic resonance cholangiopancreatography (MRCP) versus endoscopic retrograde cholangiopancreatography (ERCP): diagnostic usefulness]. Gastroenterol Hepatol. 1998 Apr;21(4):174-80.

40. Chen WX, Xie QG, Zhang WF, Zhang X, Hu TT, Xu P, Gu ZY. Multiple imaging techniques in the diagnosis of ampullary carcinoma. Hepatobiliary Pancreat Dis Int. 2008 Dec;7(6):649-53.

41. Calvo MM, Bujanda L, Heras I, Calderon A, Cabriada JL, Orive V, Martinez A, Capelastegi A. Magnetic resonance cholangiography versus ultrasound in the evaluation of the gallbladder. J Clin Gastroenterol. 2002 Mar;34(3):233-6.

42. Meng Z, Xu YK, Zhang YP. Magnetic resonance cholangiopancreatography of pancreaticobiliary duct dilation due to pancreatic carcinoma and chronic pancreatitis. Nan Fang Yi Ke Da Xue Xue Bao. 2008 Jan;28(1):113-5.

ANNEXURES

ANNEXURE I

LIST OF TABLES:

ANNEXURE II

LIST OF FIGURES:

ANNEXURE III

LIST OF ABBREVIATIONS:

CBD: Comon bile duct

CT: Computed tomography

ERCP: Endoscopic retrograde cholangiopancreatography

FOV: Field of view

FSE: Fast spin echo

HASTE: Half-Fourier acquisition single-shot turbo spin-echo

IHBR: Intra Hepatic Biliary Radicles

MIP: Maximum intensity projection

MPD: Main pancreatic duct

MR pulse: Magnetic resonance pulse

MRCP: Magnetic Resonance Cholangiopancreatography

MRI: Magnetic resonance imaging

NPV: Negative predictive value

PPV: Positive predictive value

PTC: Percutaneous transhepatic cholangiography

ROC: Receiver operations curve

TE: Echo time

TR: Repetition time

true FISP: Fast imaging with steady state free precession

TRUFI: True fast imaging with steady state free precession

TSE: Turbo spin echo

US: Ultrasound

USG: Ultrasonography

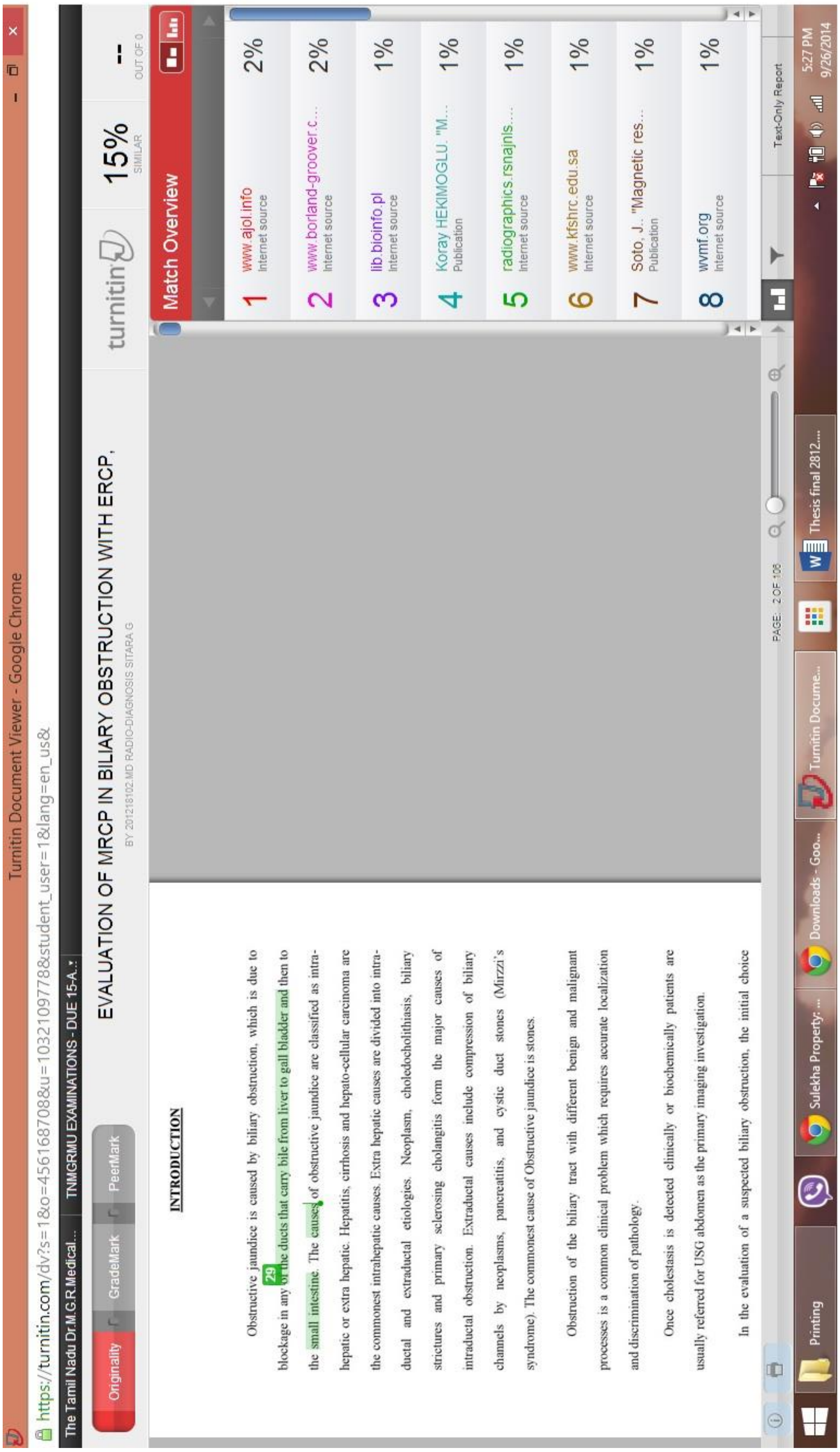
MASTER CHART

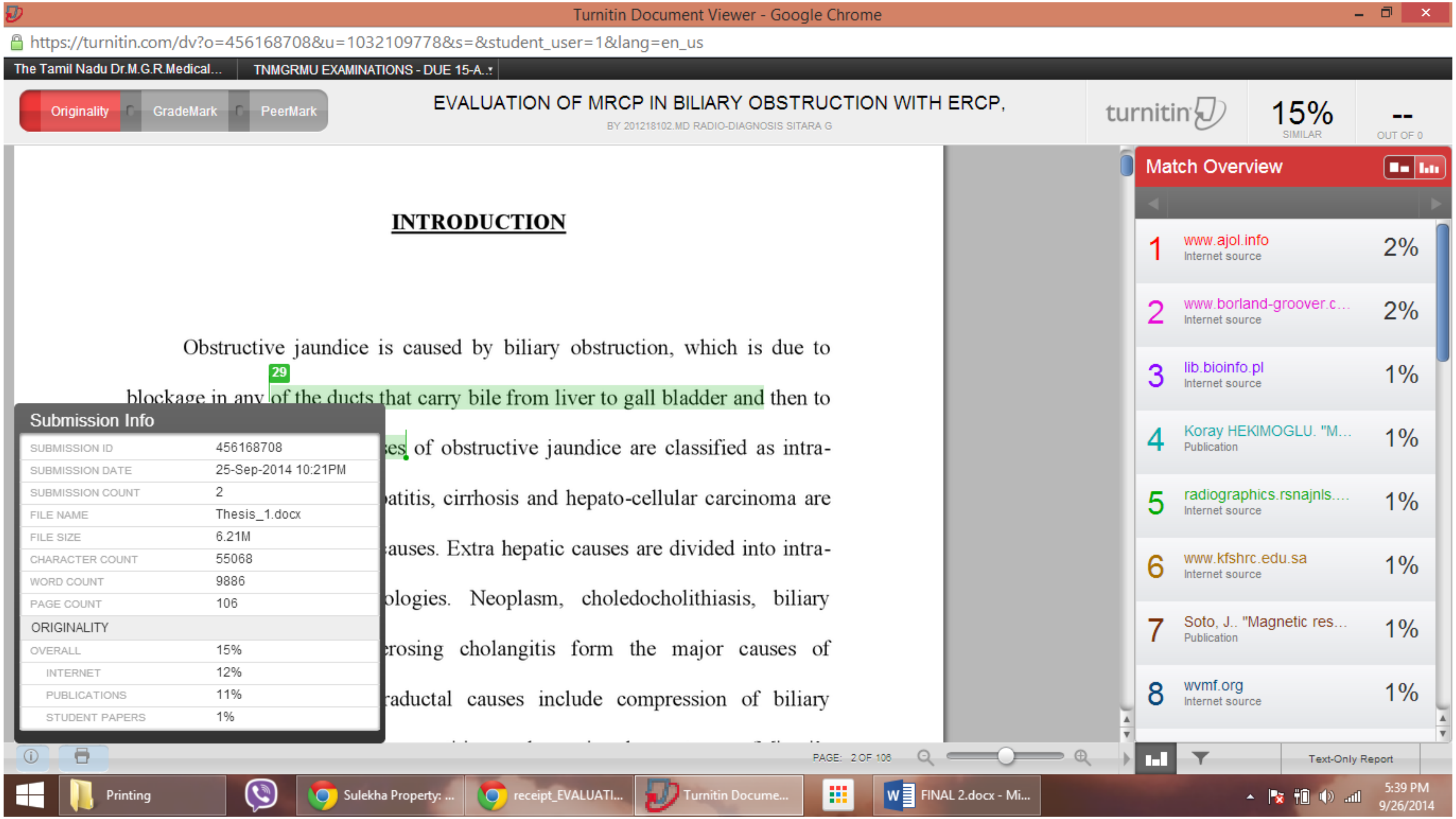
MASTER CHART

S.No	Name	Age	Sex	IHBR strictures	Bile Duct Stones	Bile duct Strictures	Bile dilatation	Bile duct Tumor	Gall Bladder stones	Pancreatic duct Dilatation	Pancreatic duct variants	Ampulla stones	Ampulla strictures	Ampulla tumor
1	alagesan	48	M		E+	M+	E+M+							
2	muthusam	65	M		E+	M+	E+M+							
3	muthusam	71	M		E+M+		E+M+							
4	SELVAKUMAR	51	M		E+M+	E+	E+M+		M+					
5	PARVATHAMMAL	49	F		E+M+		E+M+							
6	JAYANTHI	36	F			E+M+	E+M+							
7	PARVATHI	53	F		E+M+		E+M+		E+M+					
8	SELVARAJ	59	M		E+M+		E+M+							
9	HAMSAVALLI	50	F		E+M+		E+M+							
10	MAHESH	36	M			E+M+				E+M+		M+	E+	
11	VIJAYA	43	F			E+M+								
12	rajendran	49	M		E+M+		E+M+							
13	Tamilsel	16	M			E+M+								
14	Rajendran	49	M		E+M+		E+M+							
15	Padmavathy	74	F			E+M+	E+M+							E+
16	Thangararaj	48	M		E+M+		E+M+							
17	Kandhan.	66	M		E+M+		E+M+							
18	Chidambaram	61	M		E+M+				E+M+					
19	Rajalakshmi	66	F		E+M+		E+M+				M+			
20	Ayyavu.S	43	M			E+M+								
21	Veera Ragavan	59	M			E+M+						E+M+		
22	Najuma.A	64	F					E+M+						
23	Manickam	69	M		E+		E+M+							
24	Meena	66	F		E+M+		E+M+							
25	Andal.T	46	F		E+M+		E+M+							
26	Chandrakala	66	F		E+		E+M+			M+				
27	Jeevitha	29	F		E+	M+	E+M+							
28	Chandrakala	23	F			E+								
29	Ramathala	82	M			E+M+		E+M+						
30	Gandhi.V	80	M		E+M+		E+M+							
31	Palanisamy	52	M											M+ H+
32	Govindar	88	M		E+M+		E+M+							
33	Saguntha	47	F		E+M+		E+M+							
34	Kavitha.	32	F		E+M+		E+M+							
35	Ponnusamy	53	M					E+M+						
36	Manivanan	49	M		E+M+		E+M+							
37	Hamsavalli	50	F		E+M+		E+M+							
38	mallika	34	F	E+M+										
39	mani	55	M	E+M+										
40	masuba	24	F		E+M+		E+M+							

41	Gandhi.V	79	M		E+M+		E+M+			
42	Rukmani	60	F						M+	E+ H+
43	Achuthar	54	M	E+M+						
44	marimuthu	47	M							M+
45	sengodan	65	M					E+M+		
46	Indrani.	58	F		E+M+		E+M+			
47	Jeevitha	28	F		E+M+		E+M+			
48	selvam	64	M			E+M+				
49	chinnammal	65	F					E+M+		
50	Marappan	86	M					E+M+		

PLAGIARISM REPORT FROM TURNITIN.COM




Turnitin Document Viewer - Google Chrome
https://turnitin.com/dv?o=456168708&u=1032109778&s=&student_user=1&lang=en_us
The Tamil Nadu Dr.M.G.R.Medical...
TNMGRMU EXAMINATIONS - DUE 15-A...
Originality
GradeMark
PeerMark
EVALUATION OF MRCP IN BILIARY OBSTRUCTION WITH ERCP,
BY 201218102.MD RADIO-DIAGNOSIS SITARA G
turnitin
15%
SIMILAR
--
OUT OF 0
INTRODUCTION
Obstructive jaundice is caused by biliary obstruction, which is due to
29
blockage in any of the ducts that carry bile from liver to gall bladder and then to
es of obstructive jaundice are classified as intra-
atitis, cirrhosis and hepato-cellular carcinoma are
auses. Extra hepatic causes are divided into intra-
ologies. Neoplasm, choledocholithiasis, biliary
rosing cholangitis form the major causes of
aductal causes include compression of biliary
Submission Info
SUBMISSION ID 456168708
SUBMISSION DATE 25-Sep-2014 10:21PM
SUBMISSION COUNT 2
FILE NAME Thesis_1.docx
FILE SIZE 6.21M
CHARACTER COUNT 55068
WORD COUNT 9886
PAGE COUNT 106
ORIGINALITY
OVERALL 15%
INTERNET 12%
PUBLICATIONS 11%
STUDENT PAPERS 1%
Match Overview
1 www.ajol.info Internet source 2%
2 www.borland-groover.c... Internet source 2%
3 lib.bioinfo.pl Internet source 1%
4 Koray HEKIMOGLU. "M... Publication 1%
5 radiographics.rsnajnls.... Internet source 1%
6 www.kfshrc.edu.sa Internet source 1%
7 Soto, J.. "Magnetic res... Publication 1%
8 wvmf.org Internet source 1%
PAGE: 2 OF 106
Text-Only Report
Printing
Sulekha Property: ...
receipt_EVALUATI...
Turnitin Docume...
FINAL 2.docx - Mi...
5:39 PM
9/26/2014

turnitin

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	201218102.md Radio-diagnosis SITA.
Assignment title:	TNMGRMU EXAMINATIONS
Submission title:	EVALUATION OF MRCP IN BILIARY...
File name:	Thesis_1.docx
File size:	6.21M
Page count:	106
Word count:	9,886
Character count:	55,068
Submission date:	25-Sep-2014 10:21PM
Submission ID:	456168708

INTRODUCTION